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MEASURING THE EFFICIENCY OF THE INCANDESCENT LAMP.

In a letter, which appears on another page of this issue, Dean William Kent, of the College of Applied Science, Syracuse University, raises a number of questions regarding our conception of light which, in general, the photometrist is satisfied to refer to the physicist, and to accept his dictum. It must be said that our methods of measuring light are not altogether satisfactory. In fact, our knowledge of what it is we are trying to measure is far from perfect. The physicist tells us that radiant energy is merely a vibration of the ether which surrounds and penetrates all matter. He tells us, also, that there is an infinite number of possible rates of vibration; that the lower rates which human senses are able to detect are those which are recognized as heat. As the rate of vibration increases, a point is reached where the vibration affects the retina of the eye, producing the sensation recognized as light. We see first the red rays, and then pass up through the spectrum until we finally reach a point beyond which the eye again becomes insensible to the vibrations, although the rate of vibration will go on increasing—how far we know not.

Light is a physiological effect, and we know of no physical means of measuring this effect. We know that the effect on the eye is more or less proportional to the energy represented by the vibration of the ether. Whether all the energy of a visible ray is utilized in producing the effect of light we do not know, and we have no way of telling. But the physicist has taken the bull by the horns, and calls those radiations having a rapidity which will produce the effect of light in the eye "light," although, strictly speaking, "light" and "heat" are the effects produced and not the causes.

Accepting this definition, the photometrist works on the principle that all of the energy of the luminous rays is effective in producing light. He therefore says that if he measures the energy of the visible radiations, and compares this with the total radiant energy given off by the luminous body, he will obtain a ratio of the effectiveness of that particular body as a light producer; and this ratio he calls the luminous efficiency of the body.

That this is not a strictly accurate method is well recognized, but, for lack of a better, we put up with it. To show that it is not free from defects, it is sufficient to state that the eye is less sensitive to certain colors than to others. A given amount of energy in a radiation which appears as red produces less effect upon the eye than a similar quantity of energy in a green ray. It is customary in general photometric work to pay no attention to this phenomenon, and to be satisfied with a measurement of the total luminous energy.

The method of measuring these radiations is simple. The radiation is allowed to fall upon a body, which absorbs it completely, converting it into heat. By a proper arrangement of apparatus, a comparison may be made of the heat produced by the total radiation and that produced by the luminous radiations only. For instance, Angstrom's method, mentioned in our previous editorial, to which Dean Kent refers, consists in measuring the total radiation by means of a thermopile, a device which produces an electrical effect proportional to the heat developed in it, and comparing this measurement with that obtained from the luminous radiations only. The invisible radiations are eliminated by means of a prism which disperses the radiation into a spectrum, when the invisible rays which extend on each side of the visible rays are cut off by screens. The visible rays are then reassembled by a lens, and thrown on the thermopile. This, of course, is a measurement of energy in each case, but,

as mentioned above, the photometrist assumes that the energy of the visible radiations is luminous energy.

Now, as to the other questions raised by Dean Kent: the formula for the heat produced by an electric current is merely an equation expressing the relation between the electrical energy and the heat energy developed by it in a conducting body. If the temperature of a body is sufficient to render it luminous, part of the energy is given off as light, but this light is merely a special form of heat. Strictly speaking, light is only produced when this energy falls upon the eye. The luminous radiations nevertheless represent energy given off by the body, and hence must be included in the equation if it is to balance. Joule's law, as this expression is called, was deduced for bodies which did not become luminous. It is nevertheless strictly true for all bodies, whether they are luminous or not, if, instead of the symbol for heat, we substitute one for energy. In other words, it is a particular form of the law of the conservation of energy.

Accepting the physicist's idea that light is merely a particular form of heat, there is no difficulty in imagining what becomes of the light produced in a building. It is reflected from point to point, suffering absorption at every reflection, until it is transformed from a higher vibration to one of a lower period. In other words, it is converted into invisible heat. In support of this view is the fact that there are a number of physical instruments, such as the thermopile and the bolometer, which respond to a luminous radiation in the same way as they respond to a heat radiation.

As to the method of producing light in an incandescent lamp, the generally accepted idea is that the electrical energy merely produces heat. If more heat is produced at a point than can be radiated, the excess is stored up. This process goes on in the incandescent lamp until the filament becomes incandescent, finally reaching a temperature at which the energy radiated is just equal to that supplied as an electric current. We prefer to think that the electrical energy is the means of setting the atoms of the filament into vibration. The heat rays, whether luminous or non-luminous, result from the motion of the carbon filament particles. If the motion of the carbon particles is violent enough, light is given off. Strictly speaking, we do not see the carbon filament: we see the effect produced on the retina by the state of the carbon filament.

We assume light to be a form of radiant energy which is propagated through space, and is not stationary; hence it is hardly analogous to a vibrating spring which maintains a fixed position. If light is energy in motion, and produces an effect only by being converted into another form of energy when absorbed by the retina, then, obviously, for a continuous luminous effect there must be a continuous supply of energy.

There are photometric methods more refined than those usually employed, but in any case the final decision must be made by the eye. The accuracy with which this can be done is dependent largely upon the skill and training of the observer, and the possibility of error is not small. For this reason we are justified in using the simpler methods of measuring and comparing luminous radiations.

THE LIGHT OF THE FUTURE.

In an interesting article on the electrical manufacture of light, and the lamp of the future, contributed by Dr. J. A. Fleming to the March issue of the *Electrical Magazine* (London), the author gives rein to his imagination, and describes, somewhat indefinitely, his idea of the ideal lamp toward which we should strive. This lamp, he imagines, will be an exhausted glass tube containing a small body which can be made to phosphoresce when bombarded with electrons. Placed at suitable points about this body will be electrodes arranged so as to project the electrically charged matter leaving their surfaces upon the body, and thus bring it into brilliant phosphorescence. The substance which phosphoresces will be selected so as to produce, if possible, only luminous rays; or, if this can not be done, the luminous rays must greatly preponderate. In other words, we must have a cold light. We must so use the electrical energy as to produce light without converting it into heat.

The idea of using phosporescent bodies is old. The problem, of course, is to obtain a lamp which can be made to phosphoresce at will, and which will give sufficient light for practical use. Dr. Fleming's plan is based upon the following idea: it is thought by some that the luminous energy radiations which we recognize as light are produced only by vibrations of the corpuscles themselves. The longer or so-called heat rays are due to vibrations of the atoms of matter as a whole. If we can cause the corpuscles to vibrate without setting the atom as a whole into motion, we should, according to this idea, be able to produce cold light. This does not mean that the radiations do not represent energy, but merely that there are none of these lower vibrations which we usually class as heat.

We are, of course, a long way from this ideal. At the present time, we are, for a lack of a better method, forced to produce light through the medium of heat—that is to say, according to the newer idea of the method of producing luminous rays to make a body luminous, we simply, by heating it, set its atoms into such violent motions as to get the corpuscles of the atoms themselves into vibration. The useful work done is then only that which sets the corpuscles into motion. The movement of the atom as an atom gives rise to the heat rays, and except in so far as it brings about the more rapid vibrations of its corpuscles, is useless, and represents a waste of energy. We are probably as far from this ideal lamp as we are from what might be described as an ideal telephone. This we may imagine to consist of a small device somewhat similar to a mirror. When one desired to communicate with another the central would make the proper connection, and the image of the person to whom he wished to speak would appear in the mirror. He might converse with this image as he would with his friends. How this can be brought about we have no more idea, if as much, as Dr. Fleming has of his ideal light, but should our grandchildren ever reach this stage, they will wonder how their forefathers ever put up with unsympathetic hard-rubber instruments, one of which he forced against his ear, and through the other of which he talked, trusting that the person at the other end of the wire was the one to whom he wished to speak.

THE MANUFACTURE OF ELECTRICAL MACHINERY IN JAPAN.

During the World's Fair, held at St. Louis last year, much interest was shown in the few pieces of electrical apparatus exhibited in the Palace of Electricity by Japanese manufacturers. It will be remembered that there were shown telephone and telegraph apparatus and other small appliances. Besides, there was a continuous-current dynamo and a testing transformer for 150,000 volts. These machines had a very familiar look, and it seemed strange to see Japanese characters on the base instead of the name of some well-known American manufacturer. Naturally, the machines exhibited there were not large, for they had to come a long way; but the Japanese have been building fairly large electrical machinery for some years past. On another page of this issue we publish an article by Mr. William Dinwiddie, which describes the Shibaura Engineering Works, one of the two factories in Japan where the principal electrical manufacturing work is being carried on. It will be seen from this that some of the machines turned out are of a respectable size, and the photographs show that they have a very presentable appearance. It is particularly interesting to learn that these machines have not only been built by Japanese labor, but have been designed by Japanese engineers. Although the engineers who designed them were trained in foreign technical schools, and the companies have, of course, profited by the experience of others, the machines themselves stand as a product of Japanese skill and industry.

While the factories themselves and the products which they put out are interesting, probably that part of Mr. Dinwiddie's article which will be of most interest to us is the reference to the small cost of manufacturing electrical machinery in Japan. It is said that, although the Shibaura shops at which these machines were constructed are not, by any means, up to date in their equipment, electrical machinery can be turned out for thirty per cent less than the price for which the American manufacturer can deliver similar apparatus in Japan, and the question is asked what could this company do with a thoroughly up-to-date equipment? As one illustration of the methods used in Japan, it is said that the insulation of the wires is all wound on by hand, one man drawing the wire through a winding machine while the other wraps on the insulation. When a double thickness is required, this process is repeated. This is a slow method, and in this country it would be expensive. On the other hand, the Japanese have the faculty of doing things thoroughly and conscientiously, and as skilled labor is cheap, it is probable that all the work is done in a first-class manner.

Although much of the machinery used in the Japanese factories is not of the latest types, the Shibaura Engineering Works are driven in a modern manner by means of induction motors. To explain the lack of new machinery, it is said that the royalties which are asked for the use of such machines are practically prohibitive.

There are one or two other points in Mr. Dinwiddie's article which should be of interest to our manufacturers. One is the fact that the heavy machinery found in Japan, such as shears, punches and steam hammers, is all obtained from Glasgow, and Mr. Dinwiddie says that he has found this to be the case throughout the world, as the Glasgow factories have the reputation of turning out castings which are more dependable than those made in this country. Whether this belief be due to prejudice or some more substantial reason, it is time that it should be changed.

Another point of interest is the statement that the iron and steel used in Japan are secured in England. One may ask why this should be so when we are able to compete with the English manufacturer in his home market. The trip by water from the Atlantic coast to Japan is not much longer than from England to the same country, and a slight difference in time is a matter of no consequence.

Japan, at the present time, produces her own copper and mines her own coal. She is developing large iron mines in the northern island of Hokkaido. Thus, in addition to cheap skilled labor and plenty of it, she expects, within a few years, to have cheap raw material. She will then be in a position to compete with American and European manufacturers for the electrical trade of the East, and it is difficult to see how we can prevent her from getting the lion's share of it.

The electrical developments in Japan are not limited to the manufacturing side, for she possesses many valuable waterfalls, and has already entered into the development of them. This should add to her cheap raw materials and cheap skilled labor, cheap power. What more can she desire?

STATION INTERRUPTIONS.

It is reported that, during the three years of its operation, the interruptions to the service of the Northern California Power Company have amounted to but two hours and fifty-four minutes. These interruptions were due, not to any neglect of the men in charge of the plant, but to what seem to be unavoidable accidents. One was caused by a flood from the Sacramento river; two were due to short-circuits on the line, one being caused by an eagle, and the second by a goose. This is an excellent record, particularly when one remembers that the lines of this company are carried mostly across country, where there are many chances for such accidents to occur.

As an example of what may be done in city operation, where the wires are placed underground, and where there is an enormous station to care for any unexpected overloads, the record of the New York Edison Company may be mentioned. It is said that the lines of the company have not been without current for over ten years. Of course, certain circuits have been disconnected at times, but there has been no time at which some part of the system has not been in operation. Naturally, the conditions of a large city differ widely from those of a high-tension cross-country line. When the conducting wires are placed underground they are no longer exposed to the fortuitous juxtaposition of a wandering goose. There is no temptation for eagles to use them as perches. They encounter other troubles, it is true, but these seem to be less serious than the dangers to which overhead construction is exposed.

Telephony.

Mr. Herbert Laws Webb delivered the fourth and last of his series of Cantor lectures on "Telephony" before the London Society of Arts, says *Engineering*, on Monday, April 3. Having already dwelt upon the engineering side of telephone work and the details of the apparatus employed, Mr. Webb devoted the concluding lecture to a comparison of the telephonic development in various countries, and the different methods of charging in vogue. He remarked that when once telephone tariffs were mentioned a very controversial ground was entered upon; but that as far as possible he would abstain from taking advantage of his position as a lecturer to make controversial statements without giving the grounds on which they were based.

The growth of telephony, said Mr. Webb, was not extraordinary when one considered the advantages it possessed as a means of communication over its only rival in speed—the telegraph. A table on the walls of the lecture room gave the detailed steps involved in sending a message and receiving a reply by the two methods, and the approximate time required for each step. The average time from first to last for a reply to be obtained to a telegram was given as eighty-five minutes, whereas on the telephone only two minutes and forty seconds were required. The telephone service was also much cheaper, for a telegraphic message and reply cost at least one shilling, while a local conversation from a public telephone station costs only threepence, and the cost to a subscriber was no more than one penny. An alternating method of sending messages in towns was by a district messenger, but here the minimum charge was sixpence, and that only for distances not greater than half-a-mile. For long-distance messages the telegraph certainly appeared the cheapest means; but when one compared the directness of a telephonic conversation and the amount of business that could be transacted in three minutes, with the few written words of a telegram, it was evident that the telephone gave far better value for the money than the telegraph. The long-distance telephone really constituted a serious competitor with the railway, and its effect in this direction had been strikingly shown in America. Formerly, if a business man in New York wished to speak to another in Chicago, he had to make a railway journey occupying about three days, and costing perhaps £15; whereas now he naturally preferred to spend from £8 to £10 for half-an-hour's conversation over the telephone, and save, in addition, the time and discomfort of traveling. The same thing applied in a less degree in England; the double journey from London to Glasgow, for example, taking the best part of two days, and costing several pounds.

Much of the difficulty, Mr. Webb said, in connection with the telephone tariff was due to the fact that a radically wrong unit had been adopted as a basis of charging. The telephone instrument was not the proper unit; it in no way represented either the capital expenditure or the operating charges of the installation. It had become the general unit because the earliest telephone systems were of a co-operative nature, connecting up private concerns; and the flat annual rate which was equitable under such circumstances had continued after the conditions had altered. In comparison of telephone charges the flat rate was often quoted; but this was a most unfair criterion, as the cost of the service differed so greatly in different cities on account of rents, rates, and other local features. Further, when telephone matters were discussed the disputants often made statements unsupported by facts; as an example of which the lecturer mentioned that he had heard it gravely declared in New York ten years ago that the London system contained 100,000 subscribers, a flat rate of £5 was charged, and all cables were underground.

It was early discovered that the proper unit of telephone business was the message. The value of a message varied in different places with the area covered by the local system, and its cost to the company was influenced by the length of the lines it occupied. An astonishing variety of methods of charging existed in various places, of which Mr. Webb mentioned about half-a-dozen, saying that the annual flat rate, with no installation charges, was the most general. All were liable to be modified by mileage charges, by the business or residential character of the subscriber's premises, by the length of the contract, and by the size of the system—the rate sometimes increasing as the number of subscribers increased. The message rate was inaugurated in the year 1880, and found to be popular wherever applied, except in the case of the very largest telephone users. This system of charging also varied according to local circumstances. Sometimes there was a fixed "maintenance" rate in addition to a charge for each message; sometimes the maintenance rate was reduced as the contract wore out; sometimes the subscriber had to guarantee payment for a minimum number of calls; and, finally, in other places the tariff was a message rate pure and simple. It had been generally found necessary to fix a minimum charge of some sort, but the lecturer believed in time the companies would find it profitable to put in a line anywhere, and charge a simple message rate only.

To show how greatly the value of the service increased with the complexity of the system, Mr. Webb called attention to diagrams on the walls. In a simple system consisting of one exchange, with subscribers' lines radiating therefrom, the travel of a message was limited to the combined length of the two longest lines; but when two such systems were joined by trunk lines, the travel of a message was increased by the length of the trunk, and the number of intercommunications possible was more than quadrupled. In all large cities a multiple exchange area existed, every exchange being directly connected to every other one, so that no message within the area need be handled by more than two exchanges. The capital charges of connecting subscribers could be kept down by the use of a party-line to the exchange on which a number of subscribers were connected in parallel. Of course, with this method only one subscriber could use the line at a time, and messages could be overheard; but in some circumstances the cheapness of the installation outweighed these disadvantages. In some of the sparsely populated districts of America from twenty to forty subscribers used a single party-line; and telephonic advantages were thus available in districts which could not be profitably served by independent lines. On the other hand, a large telephone user often had a double connection with the exchange; one line serving for incoming and the other for outgoing calls; and manufactories and other establishments frequently had a small exchange on their own premises, allowing intercommunication, or connection with the public exchange, from every instrument.

In a city system so large a proportion of the calls had to be handled by other stations that a considerable amount of switchboard space had to be devoted to the trunk connections. In addition to this, there had to be a monitor's board to take several operators, whose duty it was to handle all difficult calls and enquiries from subscribers, which might cause delay to the regular operators. Subscribers might have changed their address, or the caller might not know their number; and calls of this nature might amount to as

many as 20,000 or 30,000 per day. In large stations it was the custom to issue a daily printed directory to keep the monitors and supervisors posted up as to the changes that took place in the system. All these facts tended to show how much greater, proportionately, was the work in serving a large area than a small one.

As regards the development of the telephone service in different countries, America was far and away ahead of Europe; in fact, it might be said that in Europe the telephone had hardly begun to be used. The state of the service in various countries and cities was shown by diagrams and tables suspended in the lecture room; some of the latter we reproduce in abstract below:

COMPARISON OF TELEPHONE SERVICE AND POPULATION IN DIFFERENT CITIES.

Town.	Telephones.	Population.	Inhabitants per Telephone.
New York.....	144,353	2,100,000	14.5
London	93,598	4,614,000	49.5
Berlin	66,744	1,931,000	29
Paris	49,444	2,660,000	54
Vienna	21,723	1,762,000	83
St. Petersburg..	6,000	1,334,000	223

TELEPHONES PER 1,000 INHABITANTS OF THE CHIEF COUNTRIES.

United States	44.8
Sweden	21.4
Denmark	16.7
Switzerland	15.9
Norway	13.8
Germany	8.9
United Kingdom	8.7
Holland	5.56
Belgium	3.5
France	3.15
Austria-Hungary	1.55

TELEPHONES PER 100 INHABITANTS IN THE CHIEF CITIES.

Stockholm	13.7
New York	6.87
Christiania	5.45
Copenhagen	4.83
Zurich	4.76
Berlin	3.45
London	2.02
Paris	1.85
Brussels	1.36
Vienna	1.21
Amsterdam	1.12

The remarkable number of telephones per inhabitant in Stockholm was due to special causes, among which was a specially active competition between the government department and a private company, in which, so far, the company had a very long lead. Strange to say, the municipal authorities were on the side of the private company, and hampered the government by preventing it from laying underground cables in the streets, to the use of which the company had the sole rights. Altogether, however, in America the development was far greater than in Europe. In some of the western parts twenty-nine per cent of the population of the district were connected up, and in a large town like San Francisco, where no competition existed, there were over 40,000 telephones, and twelve per cent of the population were connected up. Some very interesting lantern slides were shown, illustrating the different sizes and natures of the areas served by the large city systems. The London area was by far the largest, being more than thirty miles across in several directions, and covering 640 square miles. On the outline of the London area, the other city areas to be compared were thrown in succession, and made clear the enormously greater extent of the former. The Paris area, covering thirty-one square miles, appeared a compact black spot in the centre, Paris having practically no outlying suburbs, and forming an ideal telephone area. The Berlin system covered twenty-eight square miles, the suburbs being treated as separate systems. Vienna covered eighty-two square miles, much of which, however, was park and even forest land. The St. Petersburg area was twenty square miles, of which part was covered with water. Liverpool was twenty square miles, and Boston thirty-seven, this being less than one-third of the solidly built-up part of London; the Boston suburbs had separate rates which was a much more scientific method of charging. The Chicago area was very large, but only fifty square miles were as yet built up. The area of Greater New York, although much less than that of London, was treated in a much more rational way; no attempt being made to serve it as one system, but a trunk line charge being made for connections between the various quarters.

Much careful study was needed, the lecturer stated, before a suitable tariff could be drawn up for any particular district. The probable growth of the district must be considered, and the load-factor of the various portions. Subscribers were continually leaving or removing, and new ones coming on, one company having had to connect up 12,900 subscribers in eleven months, and take out 7,400 stations, which necessitated over 20,000 changes in the plant for a net increase of 5,500 customers. In another case, during three years 62,500 new stations were installed and 25,000 taken out, or 87,500 changes made in the plant for an increase of 37,000 subscribers. That sort of thing was typical of telephone work, and could only be met by providing very large facilities for alterations, otherwise the development of the system would be arrested. In St. Petersburg there was such an unsatisfied demand for extensions of the telephone system that people would pay a premium of £50 to obtain a discarded line; and in Tokio, where there were 14,000 lines in use, there were 8,000 more subscribers waiting to be connected up. Things had got into such a state that subscribers' applications were dealt in on the Stock Exchange there, and commanded good prices.

IN THE EARLY DAYS.

BY FRANK B. RAE.

The engineering department and the draughtsman were having a discussion about bonds—and deference was being given to the arguments of the draughtsman, as due to a graduate of a prominent agricultural college backed by a salary of fifteen per week. The engineering end of the debate contended that it was better to make the bonds of No. 6 iron wire instead of No. 9—that copper rivets of three-eighths-inch diameter were better than the one-fourth-inch iron rivet in vogue and that the iron wire should not only be twisted tightly around the rivets, but it should be soldered thereto; with this construction cross-bonds and longitudinal reenforcement would be unnecessary, but the draughtsman would not agree that such a radical departure from the good old way was advisable. "It might be," he said, "a good idea to solder the wire to the rivet, but iron rivets were cheaper: it was easier to drill a one-fourth-inch hole than it was to drill a three-eighths-inch hole, and a No. 9 wire made just as good an electric contact as a No. 6 wire would make—the fish-plates were the things anyway."

In the midst of the discussion, Mike came up from the front office, pointed a dirty fist with an apple core in it at the engineering department, and said, "The boss wants youse." The engineering department mussed up his hair to show he had been working, grabbed his slide-rule to keep up the bluff while passing through the testing room and went down to the room with a carpet on the floor where the general manager shaped the destinies of the street railway companies of the Middle West, carefully closing the door so that shop secrets might not reach our competitors *via* the bookkeeper. The general manager said, "You know, that I believe that in a concern like this—that is, so to speak, blazing the trail for the mightly onmarch of street railway progress—that one man can not do everything, and it is desirable to have the advice of others. I have been talking with Thompson—he was, you know, with the Mather company for several years—and he says, 'The Mather company makes a shunt motor and it has been very successful; now while your motor works and runs a car all right, Thompson says it's just a common series motor and what we need is a shunt

motor. If you know how to make a shunt motor we think you better do this."

The engineering department said he could make a shunt motor all right and while it was a good thing to run a pump with, it did not appeal to him as a street-car motor, but this was put down as professional jealously by the general manager, and the orders to make a shunt-wound street-car motor were imperative.

The discussion about bonds, the advisability of soaking battery carbon in oil for motor brushes and other things were postponed while the engineering department and the draughtsman got busy on a street-car motor of the shunt type. The motor part was easy but the speed regulation required some study. It was solved finally with a shunt field wound for nearly complete saturation, a rheostat to turn on the armature current and another to weaken the shunt field. Speed! Well, as nearly as we could figure it, speed was simply a question of the motorman's nerve, and sparkless commutation was, or was not, as Allah willed.

The outfit was sent to Saginaw to be tested and Talbot was instructed to put it under a car, and both Talbot and the car were at the depot when the engineering department arrived for the trial run. "Does she make good time—is she fast?" Frank was asked. "Time," he said, "fast" —"say! it takes two men to see that car go by—one says 'Here she comes' and the other says 'There she goes'—all that car wants is notice of a clear track."

When we passed the Bancroft House, a few minutes later, we were making about seventy-five miles an hour and we only hit the high joints from there to the end of the main street where the track made a right angle turn on an old horse-car curve, with a radius of about twenty-six feet. Talbot contended that he slowed up for this curve—perhaps he did, but it was only when we hit the curb that we noticed it, and then the retardation was quite apparent; anyway, Talbot's remarks, including those over the telephone calling for one of the common series motors to pull us back to the barn, were quite unfit for print, and some more of the stockholders' money had been used to help the "mighty onward march of street railway progress."

German Electrical Firms Combine.

A plan is announced for the amalgamation of the Lahmeyer Electrical Company, of Frankfort a. Main, with the firm of Felten & Guilleaume, of Muhlheim. The latter firm takes over the Lahmeyer company's manufacturing department, the Lahmeyer company continuing only as the financing company. The combination will have a capital of $13,750,000.

LETTERS TO THE EDITOR.

Steel Wire Worth $80,000 a Ton.

To the Editor of the Electrical Review:

Your issue of April 8 contains an editorial headed "Diamond Dies," referring to the use of such dies in drawing fine sizes of wire. The conditions governing their use are properly described with the exception that specifying 0.025-inch diameter as a size below which it is customary to draw wire through diamond dies, is somewhat misleading. The writer believes that most manufacturers of iron and steel wire have found that steel dies may be used for sizes as fine as 0.010-inch diameter.

Your editorial refers to copper wire drawn to three one-thousandths of an inch, and running six miles to a pound. A better idea of the fineness of wire is afforded by a steel wire drawn at the Roebling works. This has a diameter of one one-thousandth of an inch. One pound of the wire will reach nearly seventy miles. The wire is made from steel, the commercial value of which, in the billet, is about fifty dollars a ton. The expense of drawing is so great that a ton of the finished wire would be worth more than $80,000.

Alfred N. Barber.

Trenton, N. J., April 10.

The Efficiency of the Incandescent Lamp.

To the Editor of the Electrical Review:

In an editorial on "The Efficiency of the Incandescent Lamp," in your issue of April 8, you say: "the luminous efficiency of the incandescent lamp is generally accepted as being somewhere between four and six per cent—that is to say, of the total amount of electrical energy delivered to the lamp, only four to six per cent is believed to be converted into luminous rays." I wish you would write another article making it clear to your readers how the luminous efficiency is determined. Also what reason is there for believing that any of the electrical energy is converted into light or that light is a form of energy.

If part only of the electrical energy delivered is converted into heat and part into light, how are the two parts separately measured? If any of the energy is converted into light, what finally becomes of that light? We know that so much of the electrical energy as is converted into heat within the walls of a building finally escapes as heat by radiation or conduction into the surrounding atmosphere. The heat energy can not be destroyed without converting it into some other form of energy; but if light is produced inside the walls of a building, what becomes of it? Or if it is said to be converted into heat, how can this be known or proved?

Suppose an incandescent lamp receives current of 0.5 ampere at 100 volts or fifty watts of energy. According to the formula for generation of heat, $H = I^2R\,t$. The heat generated by this current is fifty watt-seconds, but if six per cent of the energy is converted into light then only forty-seven-fiftieths is converted into heat.

Again, supposing a platinum wire is heated successively; first, to a temperature just below the point at which light rays are visible; second, to a bright red heat, and third, to an intense white heat. At what point does the electric energy begin to be converted into light, if light is a form of energy? Is it just when the human eye recognizes the light, or is it at some lower temperature?

Is not the statement that light is a form of energy a hypothesis? And is not the statement that light is a condition of vibration just as good a hypothesis? It takes mechanical energy to cause a steel spring to vibrate, but after it has been brought up to its normal period of vibration it requires no further expenditure of energy to keep it vibrating except that necessary to overcome the resistance of the air and possibly a trifling molecular friction. So it may take heat energy to make a platinum wire white hot and to put in vibratory motion the surrounding ether, which motion causes the physiological sensation of light, but after the vibration is once established at a certain rate it may take no further energy to keep this rate constant, although it does require the continued expenditure of energy to make up for the heat lost by radiation, just as the metallic spring in vibration requires a continued expenditure of energy to overcome the air resistance.

I hope you will try to make this matter clear in a new article and that in the words of your editorial on "Popular Electricity," such an article "should recognize the necessary limitations of the man who has not, and who does not pretend to have, much knowledge of higher physics."

Wm. Kent.

Syracuse, N. Y., April 15.

[The questions raised in the above letter are dealt with in the editorial pages of this issue.—Ed.]

The Manufacture of Electrical Machinery in Japan.

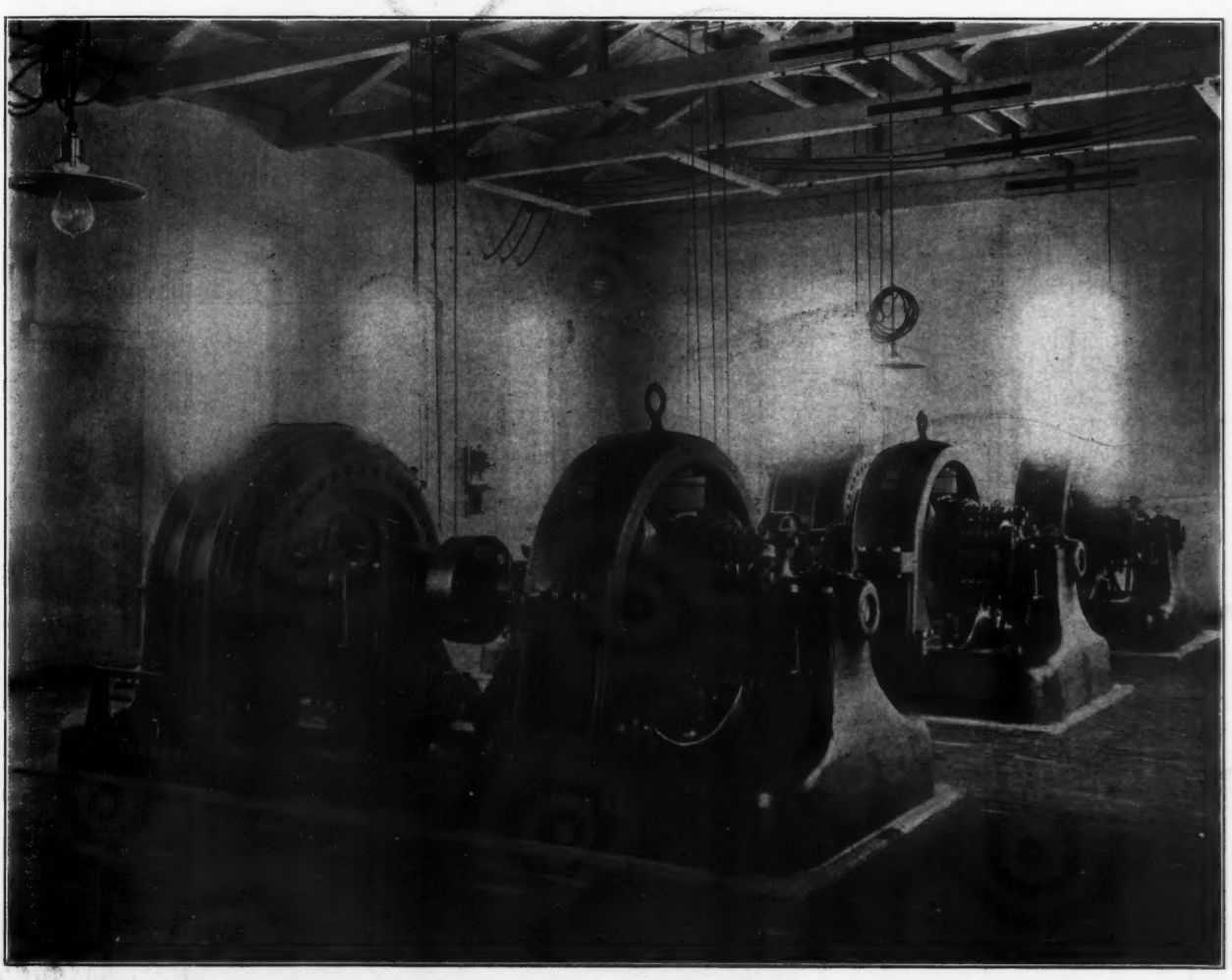
By William Dinwiddie.

AT A RECENT meeting of Japanese captains of finance and industry, one of them casually let drop the remark that the home manufacturers of electrical appliances, such as dynamos, motors, and transformers, were turning out excellent types at a cost of thirty per cent less than the same machines could be laid down in Yokohama, duty free, by any of the big American firms.

Following up this clue, the writer found that there were two well-established manufactories of electrical machinery in Japan, both less than ten years old—one at Osaka, known as the Osaka Electric Lighting Company, and one at Tokio, called the Shibaura Engineering Works, though, as a matter of fact, it is a branch of the great Mitsui Company, of Japan, which now controls one-sixth of the foreign trade of the country.

This latter plant covers several acres along the shore of Tokio bay, which offers opportunity for cheap water transportation in coasting steamers, while the other side of the works is flanked by the Tokaido double-track railway, giving access to the entire islands by rail.

The shops are all single-storied buildings, and rather cramped for floor space by the amount of machinery; as a generalization, it might be said that the quarters are inadequate and badly planned for the most economical output of the many different classes of machinery, electric and otherwise, which are manufactured.



120-Kilowatt Motor-Generators Used by Tokio Street Car Company, Tokio, Japan. Three-Phase Induction Motors, 175-Horse-Power Each. Built Entirely in Japan.

The following is a list of what this company manufactures:

Direct-current generators and motors; polyphase alternating-current generators; transformers; direct-coupled, direct-current generators; polyphase induction motors; geared-motor hoists for mines and ships; ammeters, voltmeters, switches and complete control boards; electric cranes; rheostats; ground detectors; lightning arresters; fuse blocks; single-cylinder, high-speed, automatic cutoff engines; compound, high-speed, automatic cutoff engines; marine engines, direct-coupled to dynamo; Corliss engines, simple, compound and triple expansion, condensing and non-condensing; geared pumping engines; rotary pumps and blasts; Lancashire and Cornish type boilers; turbines; seismic-proof chimneys; hand wharf-cranes; aerial wire-rope tramways; steam fumigators; Miyabara's patent water-tube boilers.

The staff and workmen are exclusively Japanese, and no foreign experts have ever been employed. The engineers are all graduates of foreign technical institutes, and the skilled workmen have either graduated from Japanese technical

colleges, or are attending night classes in these schools.

While the shops are fairly equipped with modern machinery, such as lathes, planes, gear cutters, shears, punches and screw cutters, a trip through the machine shops, the foundry, the pattern shops, the blacksmith shop, the testing rooms, and the assembling shops shows there are many special machines and labor-saving accessories missing, and some crudities are observed in handling the machines and the materials. The query naturally arises, if this factory can undersell the biggest American manufactories of electrical machinery by thirty per cent with the present equipment, what can it do with a thoroughly up-to-date plant?

For example, all the wire insulation is done by a hand winder; one operator winds on the single insulation, while another controls the reels and draws the wire through, as required. For double insulation, the wire must be passed through a second time.

In the machine shop, the writer noted a planer in operation, straightening a two-inch edge of an armature casing. The bed of the planer was traveling its full stroke, some five feet, thus leaving the cutting-tool idle fifty-nine sixtieths of the time, though a few minutes spent in adjusting the planer would have saved an hour's time.

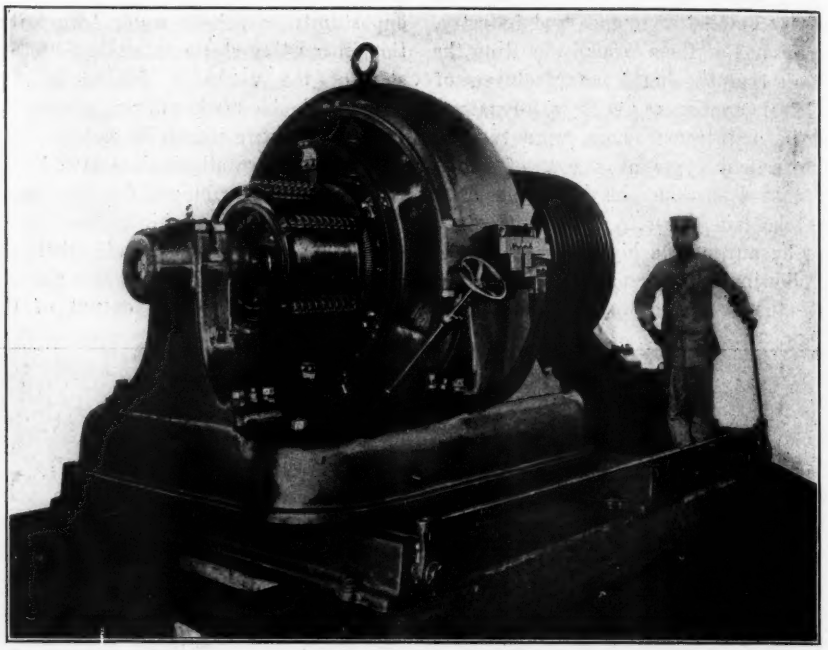
Field and armature coils were all laid on by hand, and the wire pounded into place with wooden mallets, but the work was most carefully and conscientiously executed.

Outside of one hand-driven traveling crane, a few fixed cranes and a small tramway between the various buildings, there were no devices for expeditiously handling the heavy parts and materials.

The cupola of the foundry was of ancient design and questionable efficiency.

These are all unfavorable criticisms; against them must be placed much in commendation: the machinery was all driven by a central power plant of electric generators which operated induction motors in each shop. The machinery throughout was kept in fine condition, and the hundreds of workmen were alert, quick of motion, and kept constantly at work.

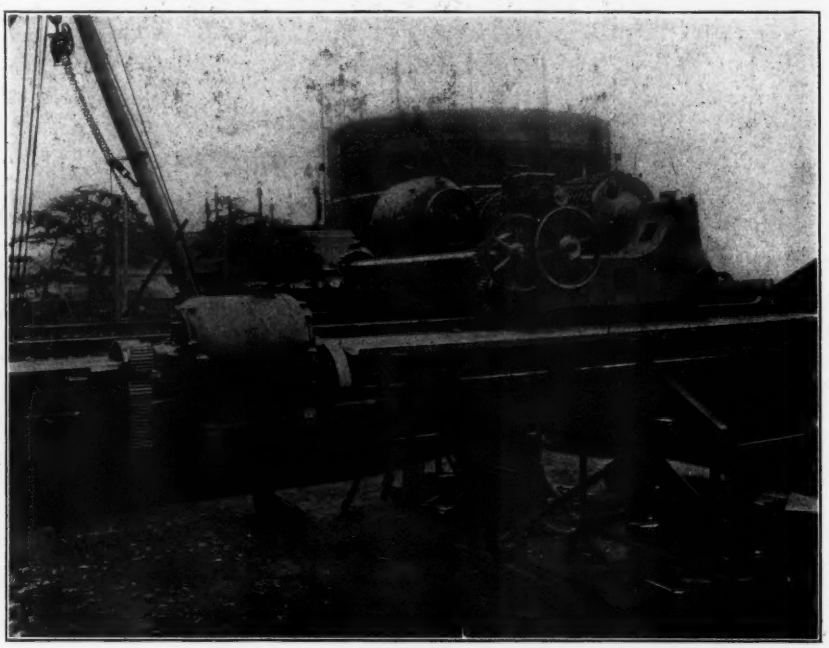
An explanation of the lack of special machines is to be had in the fact that most of the machinery for the production of electrical machinery is patented and registered in Japan by the great manufacturing firms of foreign countries, and, when they are not held for exclusive use, the royalties demanded make their employment almost prohibitive. Admitting this to be true, there must then be great opportunities in Japan for branch manufacturing companies of the corporations which control the specialized and patented machinery.



280-Kilowatt, Direct-Current Generator, Used by the Imperial Dockyards, Yokohama.

Most of the machinery is of American make, and no particular machine firm seems to have been given a preference. The heavy machinery, such as shears, punches and steam hammers, is of Glasgow manufacture, and in this connection let it be said, incidentally, the writer has noticed that the trade generally, throughout the world, usually buys its massive machinery in Scotland, in preference to the United States, and the answer to the "Why" is often that it is more dependable, having less flaws in the castings.

As will be seen from the list of goods manufactured, this company furnishes complete electric plants for power and lighting, and it also installs the same. The largest generator so far manufactured is a direct-current generator of 373 horse-power for the Imperial Dock-



Twenty-Ton Electric Crane, Used by Nippon Railroad Company. The First Electric Crane Built in Japan.

yards, at Yokosuka, which has been in constant use for two years driving motors. The largest engine ever built by it is over 1,000 indicated horse-power. It is in use in one of the large southern cotton mills.

The Tokio Electric Street Car Company has three pairs of 120-kilowatt motor-generators, produced by this works. The motors are of the three-phase induction type and operate at 3,000 volts. The Street Car Company originally bought its current, but now generates it itself.

The first electric crane ever manufactured in Japan was made by the Shibaura company for the Nippon Railway Company. It is of twenty tons capacity and has been in constant use for five years.

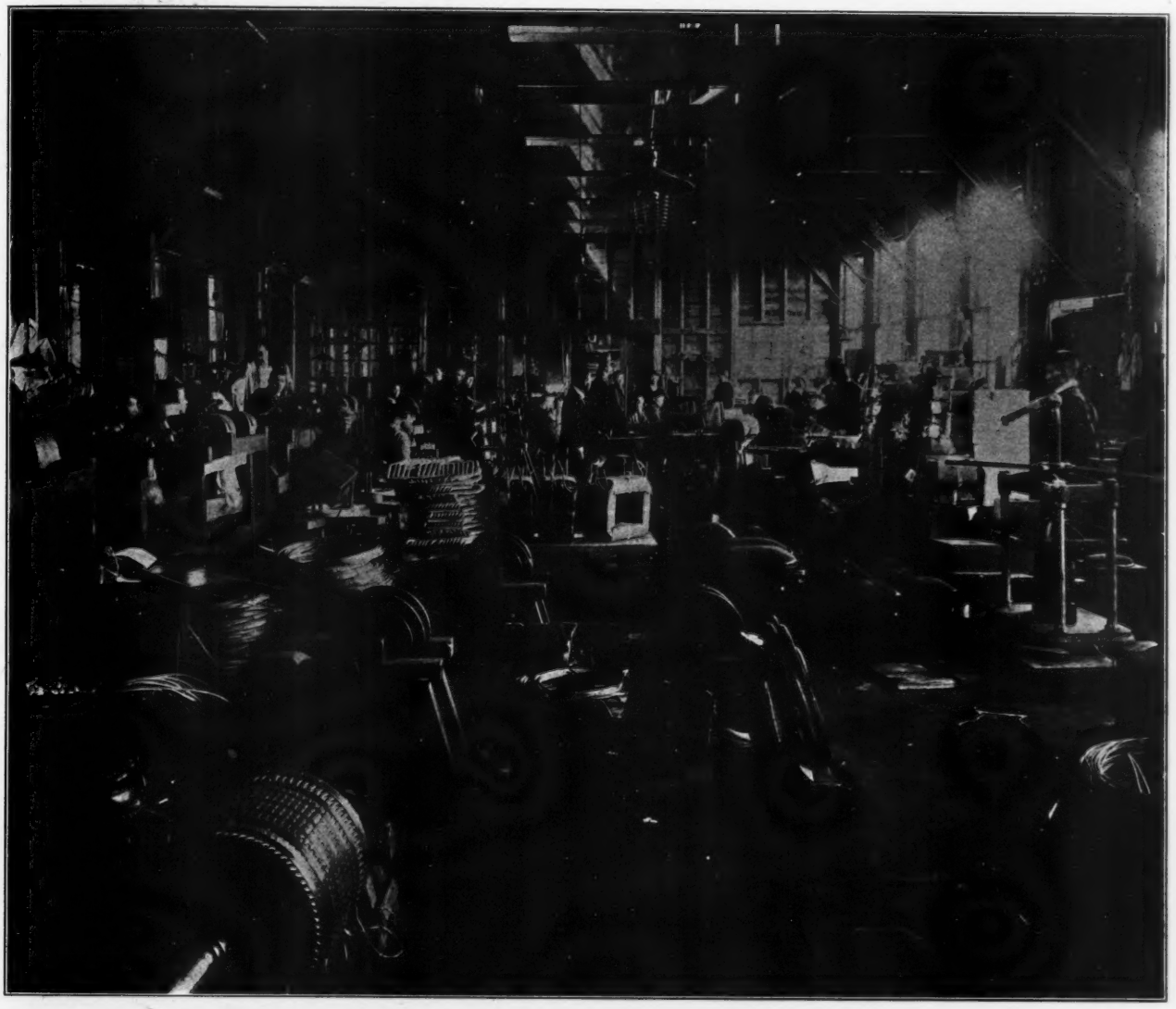
The growth of the company, electrically, in four years is shown in a very interesting series of production cards which carry data on the number of machines, the energy and the repairs required. In 1901 twenty-three direct-current generators with an aggregate of 340 kilowatts were manufactured; in 1904 the number had risen to sixty-five and the capacity to 1,450 kilowatts. For the same years the alternating generators stood, respectively, four and twelve, with capacities of 275 and 1,300 kilowatts. Direct-current motors increased from five to thirty-six with capacities of 190 and 600 horse-power and alternating-current motors from forty to sixty with energies from 250 to 1,550 horse-power. Transformers in the same time rose from 350 of a total of 1,450 kilowatts to 910 of 4,050 kilowatts.

The repair cards for the guaranteed generators, motors and transformers show a steady falling off in percentages until in 1904 the necessary repairs represented something less than five per cent of the output. The managers explain this reduction as due to the increased skill gained by the operators of electrical devices; it is also probably due to greater excellence of the factory product.

All the copper wire is made in Japan of copper from Japanese mines. The fibre insulation is also of home manufacture, but all the steel and iron plates and bars come from England, as well as most of the insulating materials, such as mica and asbestos. Some pig iron is brought from England, but a large part of it is from Japanese furnaces.

The iron and steel supply is brought from England, it is said, because so far the United States market has not been able to meet Great Britain's prices. Though the difference in time of transportation of such materials to Japan is fully two weeks in favor of the United States, the railway tariff across our continent more than overbalances the cheap, slow, all-water transportation from England.

The story of the low-cost price of production in the manufacture of electrical



ARMATURE, FIELD COIL AND TRANSFORMER WINDING SHOP, SHIBAURA ENGINEERING WORKS, TOKIO, JAPAN.

machinery in Japan—and, in fact, of most of the other manufactured products—is told in the three words, cheap, skilled labor. The technical experts and engineers of the firm under discussion receive salaries of seventy-five dollars per month; first-class mechanics receive sixty cents gold a day; armature and field finishers, sixty-five cents a day; the finest pattern-makers—and they equal our expert men—get seventy-five cents gold, and the smith, moulder and boilermaker receive sixty cents gold.

The working-day is ten hours long.

The great industrial future of Japan is assured for four reasons: 1, the workmen are naturally clever and skilful with their hands, learning their tasks easily and rapidly, and, though short in stature, they are heavily muscled and of robust constitution, which makes for sustained manual effort and maximum production; 2, the immense population in a limited area, increasing annually over half a million souls, assures an abundant supply of cheap labor; 3, the markets of the great Far East are at her very doors, and 4, she has an abundant supply of coal and copper at home—and probably also of iron.

The coal production of Japan in fifteen years has increased eight times; in other words, in 1904 it was over ten million tons, as against a little over a million tons, and to-day sixty per cent of the coal is exported, while forty per cent is used for home consumption. Large iron mines are being developed in the northern island of Hokkaido, and it is believed that ore can be laid down from these mines in the southern ports of Japan at $1.75 gold per ton. In 1904 seven million yens' worth of copper from Japanese mines was exported to China and several million yens' worth was consumed at home.

It will thus be seen that in a few years, with cheap labor and raw products at home, Japan will be in a position to compete with foreign countries not only for the electrical supply trade of the East, but she will enter the market for most of the manufacture of iron, as she is already in the China field with engines and boilers.

However, that the home products of electrics have not yet become a serious menace to the foreign trade is evidenced in her import figures of these supplies. In 1900 she imported $150,000 gold worth of electric machinery, and in 1904 half a million dollars gold, of which latter sum three hundred thousand dollars' worth were purchased from the United States.

As a matter of fact, Japan is only in her infancy, electrically, but with the many corporate lighting and power schemes now on foot and being discussed she may be expected to grow tremendously in another ten years.

The mountainous islands, girt with narrow seaboards, offer wonderful possibilities in economical water power, but so far no attempt at long-distance trans-

Assembling Shop for Generators and Motors, Shibaura Engineering Works, Tokio, Japan.

mission of electricity has been made with the single exception of a lighting and power plant at Hiroshima, on the Inland sea where a 10,000-volt current is carried twenty miles to the city. A 5,000,000-yen company has been incorporated in Tokio for the purpose of establishing a high-potential line into the city from the Katsura river falls some forty miles distant. It is the intention to deliver at the start 10,000 horse-power at the Tokio end of the line.

The rapid expansion of the use of electricity in Japan for the next few years, at least, will offer opportunities to the foreign markets of which our dealers should be on the alert to take advantage, but by far the greater return is to be had by establishing well-equipped and modern manufacturing plants in Japan itself.

The Great African Telegraph Line.

The telegraph line which is to run from the Cape to Cairo, the length of the continent of Africa, has reached, from the south, Udshidshi, on the shores of lake Tanganyika, in German East Africa. A survey is now being made to find the best connecting route with the north, and the line already established is to be examined and improved. It is presumed that the connecting link will run along the east shore of the great Victoria lake, thence in a northerly direction to reach Rosares, at present the last telegraph station in the Soudan. Considerable difficulty will have to be overcome, as a swamp of 100 miles in length exists north of Udshidshi, where it will be difficult to run a reliable air line. It was intended to run around this swamp, but it has now been determined to utilize wireless telegraphy for communication across. This system, however, will probably be temporary.

Telephone Rates in Great Britain.

In an editorial in the Canadian *Engineer* for April, the following interesting table relative to telephone rates in Great Britain and Ireland is given:

LONG-DISTANCE TELEPHONE CHARGES AND TERMINAL FEES IN GREAT BRITAIN AND IRELAND.

	Distance. Miles.	Long-Distance Charge. Dollars.	Terminal Fee. Cents.	Total. Dollars.
Up to	25	0 06	6	0.12
"	50	0.12	6	0.18
"	70	0.18	6	0.24
"	100	0.24	6	0.30
London to Birmingham	105	0.36	6	0.42
Nottingham	110	0.36	6	0.42
Manchester	165	0.48	8	0.56
Swansea	170	0.48	8	0.56
Liverpool	180	0 48	8	0.56
Plymouth	200	0.60	8	0.68
Newcastle-on-Tyne	260	0.72	8	0.80
Edinburgh	340	0 96	12	1.08
Glasgow	365	1.10	12	1 22
Dundee	377	1.10	12	1.22
Belfast	404	1.34	12	1.46
Aberdeen	435	1.22	12	1.34
Inverness	453	1.34	12	1 46
Dublin	491	1.58	12	1.70
Cork	619	1.94	12	2.06

HOW TO REMEMBER THE WIRE TABLE.[1]

BY CHAS. F. SCOTT.

The wire table for the B. & S. gauge copper wire has a few simple relations, such that if a few constants are carried in the memory the whole table can be constructed mentally with approximate accuracy.

Resistance—A wire which is three sizes larger than another wire has twice the weight and half the resistance.

No. 10 wire has a resistance of 1 ohm per thousand feet; No. 7 wire, which is three sizes larger, has 0.5 of an ohm per thousand feet; No. 4 wire, which is three sizes larger than No. 7, has 0.25 of an ohm; No. 13 wire, which is three sizes smaller than No. 10, has 2 ohms; No. 16 wire, which is three sizes smaller than No. 13, has 4 ohms. It is easy, therefore, knowing the resistance of No. 10, to find the resistance of No. 7, No. 4, No. 1 and No. 000; also of No. 13, No. 16, No. 19, etc.

A wire which is ten sizes larger than another wire has ten times the weight and one-tenth the resistance.

As the resistance of No. 10 is 1 ohm per thousand feet, the resistance of No. 0 is 0.1 of an ohm, and the resistance of No. 20 wire is 10 ohms. As the resistance of No. 4 is 0.25 of an ohm, the resistance of No. 14 is 2.5 ohms and of No. 24, 25 ohms.

In the following table the first column contains the sizes of wire which differ from one another by three sizes. The resistance of each wire in this column is seen to be twice that of the next larger size and one-half that of the next smaller size. There is, therefore, no difficulty in remembering this column. In the second division of the table the wires are ten sizes smaller than those in the first division; thus No. 11 corresponds to No. 1 and the resistance is ten times as great. In the third division of the table the wires are ten sizes larger than those in the first division; thus No. 0 corresponds with No. 10 and the resistance is one-tenth as great.

Size.	Ohms.
No. 1	0.125
No. 4	0.25
No. 7	0.5
No. 10	1
No. 13	2
No. 16	4
No. 19	8
No. 22	16
No. 25	32
No. 11	1.25
No. 14	2.5
No. 17	5
No. 20	10
No. 23	20
No. 26	40
No. 29	80
No. 32	160
No. 35	320
No. 0000	0.05
No. 0	0.1
No. 3	0.2
No. 6	0.4
No. 9	0.8
No. 12	1.6
No. 15	3.2

From this table several new relations may be observed.

If the wire is one size smaller the resistance is twenty-five per cent greater. For example: compare No. 11 with No. 10, No. 12 with No. 11, No. 13 with No. 12, etc.

If the wire is two sizes smaller the resistance is sixty per cent greater. For example: compare No. 12 with No. 10, No. 16 with No. 14, No. 15 with No. 13.

If the wire is one size larger the resistance is eighty per cent of that of the smaller wire. For example: compare No. 9 with No. 10, No. 10 with No. 11.

If the wire is two sizes larger the resistance is sixty-three per cent of that of the smaller wire. For example: compare No. 11 with No. 13, No. 4 with No. 6.

From the foregoing the following are the ratios of resistance between the wires of consecutive sizes:

0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00.

Weight—The weight of a wire is inversely proportional to its resistance. Therefore, the foregoing relations are the same for weight as for resistance, excepting that the weights increase as the size of the wire increases, instead of diminishing. The weights of successive sizes of wire, therefore, bear the following relation, beginning with the smaller wire:

0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00.

If the weight of any size of wire is known, it is therefore seen that the weight of the next larger size is twenty-five per cent greater; the weight of the second larger size is sixty per cent and the weight of the third larger size is double; also, the weight of the sixth larger size will be four times as great, and the weight of the tenth larger size will be ten times as great.

The weight of 1,000 feet of No. 10 copper wire is 31.4 pounds. Therefore, the weight of No. 7 wire is 62.8 pounds; the weight of No. 0 wire is 314 pounds. The weight of No. 5 wire is 100 pounds per thousand feet, which is a convenient figure to remember. The weight of No. 2 wire is, therefore, 200 pounds, and the weight of No. 00 wire is 400 pounds.

AREA.

The area of No. 10 wire is approximately 10,000 circular mils (more pre-

[1] *Electric Club Journal*, April.

cisely 10,380). The area is proportional to the weight. The area of No. 7 wire is, therefore, about 20,000 circular mils, of No. 0 wire 100,000 and of No. 0000 wire 200,000. The precise area of No. 10 wire is 10,380 circular mils. Taking this figure for easy calculation as 10,400 and following the process above indicated, the area of No. 0000 wire is found to be 208,000, which is very nearly 211,600, the figure in the wire table.

DIAMETER.

The diameter of No. 10 wire is approximately 0.10 inch (more precisely 0.102 inch). The diameters follow the same ratio as the circular mils and weights except that this ratio applies to alternate sizes. Therefore the sixth smaller size has half the diameter and the twentieth smaller size has one-tenth the diameter. Therefore, as No. 10 is 0.10 inch, No. 16 is 0.05 inch and No. 30 is 0.01 inch; also No. 4 is 0.20 inch, and No. 000 is 0.40 inch; also No. 0 (two sizes smaller than No. 000) has eighty per cent less diameter, or 0.32 inch. No. 00, lying between these sizes, may be presumed to be about ten per cent less than No. 000, or 0.36 inch; the diameter given in the wire table is 0.3648.

Reference to a complete wire table will show that the figures in the above examples and other figures which may be determined in the same way are correct within a few per cent. A little practice in mental arithmetic will enable any one to determine the approximate weight and resistance of wire of any size.

SUMMARY.

The things to be remembered regarding B. & S. gauge copper wire are the following:

A wire which is three sizes larger than another wire has half the resistance, twice the weight and twice the area. A wire which is ten sizes larger than another wire has one-tenth the resistance, ten times the weight and ten times the area.

No. 10 wire is 0.10 inch in diameter (more precisely 0.102); it has an area of 10,000 circular mils (more precisely 10,380); it has a resistance of 1 ohm per thousand feet at twenty degrees centigrade (68 degrees Fahrenheit), and weighs thirty-two pounds (more precisely 31.4 pounds) per thousand feet.

The weight of one thousand feet of No. 5 wire is 100 pounds.

The relative values of resistance (for decreasing sizes) and of weight and area (for increasing sizes) for consecutive sizes are:

0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00.

The relative values of the diameters of alternate sizes of wire are:

0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00.

CIRCULAR MILS.

Conductors of large size are usually specified in circular mils; for example, 500,000 circular mils, 750,000 circular mils.

As No. 10 wire has approximately 10,000 circular mils and a resistance of 1 ohm per thousand feet and as the length of a wire which has a given resistance is proportional to its area, it follows therefore that the length in feet of a copper conductor having a resistance of 1 ohm may be found by dropping one cipher from the number expressing its circular mils, for example, No. 10 wire has 10,000 circular mils and a resistance of 1 ohm per 1,000 feet; a 300,000 circular mil conductor has a resistance of 1 ohm per 30,000 feet and a 1,000,000 circular mil conductor has a resistance of 1 ohm per 100,000 feet. The weight of a given length is proportional to the area; therefore, the weight of a conductor having 500,000 circular mils is greater than that of No. 10 wire in the same ratio that its area is greater. Five hundred thousand circular mils is fifty times that of No. 10 wire or approximately fifty times thirty-two pounds, which equals 1,600 pounds per thousand feet. In this way the approximate characteristics of copper conductors of all sizes may be quickly ascertained.

To find resistance, drop one cipher from the number of circular mils; the result is the number of feet per ohm.

To find weight, drop four ciphers from the number of circular mils and multiply by the weight of No. 10 wire.

Electric Tramways and Light Railways in England.

Under date of February 22, 1905, United States Consul-General H. Clay Evans, London, transmits the following article, published in the London *Daily Express* of even date, under the heads of "Triumph of Electricity," and "Remarkable Figures as to Its Use on British Tramways." In the printed extract herewith pounds sterling have been reduced to dollars in the Bureau of Statistics.

"The triumphant march of electricity, as applied to tramways and light railways, is shown in a Board of Trade return issued yesterday, giving the figures for street and road tramways for 1903-'04, with comparative statistics for past years.

"The return covers the period from 1878 to 1903-'04, and divides it into three periods—horse, steam and electricity. The maximum year of the horse period was 1879, that for the steam period 1898, while the use of electricity is still growing. A selection from the figures given in the return shows some of the results of the new method of traction:

LENGTH OF LINES, NUMBER OF PASSENGERS CARRIED, NET AND GROSS RECEIPTS, AVERAGE FARE PER PASSENGER, AND CAPITAL INVESTED ON BRITISH TRAMWAYS, 1879, 1898 AND 1903-'04.

Item.	1879.	1898.	1903-'04.
Miles of route open	269	1,604	1,840
Passengers carried	146,000,223	858,485,542	1,799,342,673
Passengers carried, per mile	469,641	806,703	977,961
Net receipts ....dollars..	1,123,947	5,120,682	14,171,783
Gross receipts ....do....	5,349,602	22,191,853	41,875,668
Average fare per passenger....cents..	3.68	2.46	2.2
Capital ....dollars..	20,475,069	80,262,547	235,788,952

"In 1898, 38,777 horses and 589 steam locomotives were employed on the tramways. In 1903-'04 there were only 15,353 horses and 249 steam locomotives. The places of those which have gone have been taken by 7,132 electric cars. In other words, over 1,460 miles of tramway and light railway line are now under electric traction, and only 235 under horse and 108 under steam.

"Of the total of 312 tramway and light railway undertakings in the United Kingdom, 162 are now owned by local authorities, with a total of 1,147 miles of track. A total capital expenditure of £28,060,524 ($136,556,541) has been incurred by local authorities.

"From the profits of these municipal undertakings a sum of £207,087 ($1,007,789) was, in 1903-'04, handed over to the relief of the rates. Among the places at which this satisfactory result was achieved were the following:

SUMS HANDED OVER FROM THE PROFITS OF MUNICIPAL TRAMWAYS AND LIGHT RAILWAYS TO THE RELIEF RATES OF CERTAIN CITIES.

Cities.	Paid to the Rates.
Leeds	$253,058
Manchester	243,325
Liverpool	134,661
Glasgow	124,662
Nottingham	63,264
Salford	58,398
Hull	55,955

"Other interesting figures given in the return show that the tramways and light railways paid £287,733 ($1,400,253) in rates and taxes, and that £1,239,121 ($6,030,182) was paid in dividends."

SEMI-ANNUAL CONVENTION OF THE NATIONAL MACHINE TOOL BUILDERS.

SPRING SESSION HELD AT WASHINGTON, D. C., APRIL 11 AND 12.

The semi-annual convention of the National Machine Tool Builders was held at the Arlington Hotel, in Washington, D. C., April 11 and 12, and proved to be one of the most interesting and important meetings which that organization has held. The association was organized four years ago and is doing valuable work in promoting the interests of its members. It holds two meetings each year, the regular annual meeting in New York city, in the autumn, while the spring meetings are held at various other places. The membership of the association comprises the following manufacturing firms and corporations:

The Hendey Machine Company, Torrington, Ct.

B. F. Barnes Company, Rockford, Ill.

Detrick & Harvey Machine Company, Baltimore, Md.

Baush Machine Tool Company, Springfield, Mass.

P. Blaisdell & Company, Worcester, Mass.

Draper Machine Tool Company, Worcester, Mass.

Prentice Brothers Company, Worcester, Mass.

F. E. Reed Company, Worcester, Mass.

Whitcomb Manufacturing Company, Worcester, Mass.

Woodward & Powell Planer Company, Worcester, Mass.

Norton Emery Wheel Company, Worcester, Mass.

C. E. Sutton Company, Toledo, Ohio.

Flather & Company, Incorporated, Nashua, N. H.

Mark Flather Planer Company, Nashua, N. H.

Binsse Machine Company, Newark, N. J.

Gould & Eberhardt, Newark, N. J.

W. P. Davis Machine Company, Rochester, N. Y.

W. A. Wilson Machine Company, Rochester, N. Y.

The American Tool Works Company, Cincinnati, Ohio.

Bradford Machine Tool Company, Cincinnati, Ohio.

Bickford Drill and Tool Company, Cincinnati, Ohio.

Cincinnati Milling Machine Company, Cincinnati, Ohio.

Cincinnati Planer Company, Cincinnati, Ohio.

Cincinnati Shaper Company, Cincinnati, Ohio.

Dietz Machine Tool Company, Cincinnati, Ohio.

Fosdick Machine Tool Company, Cincinnati, Ohio.

Greaves, Klusman & Company, Cincinnati, Ohio.

Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.

R. K. Leblond Machine Tool Company, Cincinnati, Ohio.

The King Machine Tool Company, Cincinnati, Ohio.

The Queen City Machine Tool Company, Cincinnati, Ohio.

Rahn, Mayer Carpenter Company, Cincinnati, Ohio.

Schumacher & Boye, Cincinnati, Ohio.

Hamilton Machine Tool Company, Hamilton, Ohio.

Springfield Machine Tool Company, Springfield, Ohio.

Owen Machine Tool Company, Springfield, Ohio.

Jones & Lamson Machine Company, Springfield, Vt.

The Ridgway Machine Tool Company, Ridgway, Pa.

G. W. Fifield, Lowell, Mass.

Stockbridge Machine Company, Worcester, Mass.

Windsor Machine Company, Windsor, Vt.

John Steptoe Shaper Company, Cincinnati, Ohio.

Builders' Iron Foundry, Providence, R. I.

The delegates in attendance at the Washington convention were the following:

William Lodge, president of the association, representing Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.

P. E. Montanus, secretary of the association, representing the Springfield Machine Tool Company, Springfield, Ohio.

Enoch Earle, treasurer of the association, representing P. Blaisdell & Company, Worcester, Mass.

F. W. Boye, Jr., Schumacher & Boye, Cincinnati, Ohio.

B. B. Quillans, Cincinnati Planer Company, Cincinnati, Ohio.

H. L. Flather, Flather & Company, Incorporated, Nashua, N. H.

Chas. S. Gingrich, Cincinnati Milling Machine Company, Cincinnati, Ohio.

Geo. O. Gridley, Windsor Machine Company, Windsor, Vt.

L. M. Anderson, Cincinnati Shaper Company, Cincinnati, Ohio.

Fred. L. Eberhardt, Gould & Eberhardt, Newark, N. J.

C. H. Alvord, Hendey Machine Company, Torrington, Ct.

Murray Shipley, Dietz Machine Tool Company, Cincinnati, Ohio.

Edward M. Woodward, Woodward & Powell Planer Company, Worcester, Mass.

W. P. Davis, W. P. Davis Machine Company, Rochester, N. Y.

V. F. Prentice, Prentice Brothers Company, Worcester, Mass.

J. W. Carrol, Draper Machine Tool Company, Worcester, Mass.

W. A. Wilson, W. A. Wilson Machine Company, Rochester, N. Y.

O. M. Flather, Mark Flather Planer Company, Nashua, N. H.

J. S. Detrick, Detrick & Harvey Machine Company, Baltimore, Md.

E. P. Bullard, Bullard Machine Tool Company, Bridgeport, Ct.

The proceedings of the convention were conducted in executive session in accordance with a standing rule of the association. The subjects announced for formal report and discussion were as follows:

"Conditions of Trade."

"Standardization of Motor Drives."

"Tariff Revision."

"How Best to Offset the Exceeding Diligence of the German Nation in the Acquisition of the Markets of the World."

"A Revision of the Apprenticeship Question."

"A Further Revision and Addition of the Prices of Detail Parts of Machine Tools."

"Relative Cost of Power for Belt-Driven and Motor-Driven Machine Shops."

"Patent Laws Particularly Applicable to Machine-Tool Builders."

"Types of Machine Tools to Sell at Their Proper Value."

"Advantages of the Motor Drive and Greater Power Necessary in the Belt Drive for Machine Tools"

"Foundry Work and the Advantages of an Up-to-Date Foundry for the Machine-Tool Manufacturer."

Mr. G. Herbert Condict, vice-president of the Electro-Dynamic Company, of Bayonne, N. J., appeared before the convention, by invitation, and explained the principles and construction of the motor made by his company and answered questions propounded by the members regarding its applicability to the various needs of the work in which they are engaged. Mr. Condict had on exhibition before the convention one of his latest motors which elicited the greatest interest and admiration. It was run at greatly varying speeds, under all conditions of load, and could be instantly reversed at any moment. The general sentiment of the delegates favored the substitution of independent electric motors for the cumbersome and inconvenient systems of shafting and belting now in use in many of the factories.

The convention finally adjourned at twelve o'clock on Wednesday, April 12, and the rest of that day was spent by the delegates in visiting points of interest in Washington.

THE UNITED STATES NAVY'S FLOATING REPAIR SHIP.

BY GEORGE E. WALSH.

One of the most unique and, in its particular field, most important crafts constructed in recent years by the Navy Department is the new floating repair ship shortly to be launched from the New York navy yard. As a miniature floating navy yard, the craft possesses many features entirely new in the field of marine architecture. Work has been progressing rapidly on the ship lately, and it will be in service within a short time. The experimental nature of the boat must eventually demonstrate the value of a floating repair shop which can perform all the work for ordinary warships without necessitating dry-docking.

The design and construction of the ship is due to Naval Constructor William J. Baxter, and the development of the idea has been the result of many years of study on the part of the best marine architects connected with the navy. The cost in time and money to dock a modern cruiser or gunboat for making some slight repairs either to the craft or the guns and armament has always been a serious problem. Frequently these repairs are of so slight importance that they are deferred from time to time, and in the end they cause a good deal of trouble through delay. The use of a dry-dock for making small repairs, or even the use of the navy yard, complicates matters by delaying work of a more important character on other ships. A floating repair ship could therefore simplify the problem by doing the work off Tompkinsville, S. I., or anywhere in the bays or rivers of the coast.

The efficiency of such a floating repair shop naturally depends entirely upon the completeness of its equipment, and no effort has been spared to make this as perfect as possible. The new craft when put in commission will represent the most perfect naval repair shop in existence. Economy of space has been considered so that every possible square inch above and below decks has been made available.

The floating repair ship is 120 feet in length, 40 feet wide, and designed to draw only six feet of water. This will permit it to float in shallow bays and rivers to do work on small draught gunboats, torpedo boats and torpedo-boat destroyers. With this object in view the boat has been constructed with a generous beam, and with watertight compartments which can be filled and emptied at ease.

Constructed entirely of steel it can stand almost any strain imposed upon it. It is practically non-sinkable, and it can be towed through almost any kind of a sea that a cruiser can navigate. It will contain no self-propelling power, for every square inch is utilized for machinery for repairing other ships.

At one end of the ship is built a steam derrick with a total lifting capacity of twenty tons. This derrick is intended to lift the heavy ordnance and gun carriages from cruisers and torpedo boats, and to lower them in the shops below decks. The weight of this derrick at one end is offset by the boilers and furnaces located at the opposite end. The boilers furnish steam for driving the different machines and dynamos on the ship as well as to operate the huge derrick.

The repair shop is divided into two sections—the deck shop and the interior shop below. Work that can be performed better on the deck will have the advantage of more space and freedom of operation. The two repair shops are located amidships, and there will be found in them practically every tool and machine that the ordinary navy yard is equipped with. These include a miscellaneous assortment of electrical and pneumatic tools—lathes, drills, slotters, shears and punches.

The roof of the repair shop is fitted with big skylights which can be automatically removed to admit parts of another ship to be repaired. By means of the huge steam derrick, guns, carriages and other parts of a cruiser can be lowered through the open skylights, and when closed work can progress in stormy weather. Sufficient light filters through the glass covering to enable the workmen to operate their machines in ordinary weather. But a perfect system of electric lighting has been installed so that no cessation of work need be caused by the weather. Provisions are made for night and day shifts of workmen, and in emergencies repair work on cruisers could go on twenty-four hours in the day.

Provision is made for repairing the superstructure and deckwork of small cruisers and gunboats. By running the repair ship close up to a cruiser, the pneumatic and electrical tools and machines could be carried on the deck or along the side of the craft. Thus riveting and bolting of loosened plates could be repaired. A cruiser that had collided with a dock or another ship could have her bow entirely replaced with new plates without going into dry-dock. Work can be carried down to the water line on the damaged ships, and only injuries extending below the water line would necessitate the dry-docking of ordinary small cruisers, gunboats and torpedo crafts.

The portable nature of the electric tools is a feature of the new floating shop. Electric current furnished by the dynamos can be carried to any part of the deck of a cruiser by uncoiling wires, and the small drills, slotters, punches and lathes can thus be carried to the far side of the ship. Workmen can operate over a wide field by means of this system, and power is always furnished them in abundance. While riveting plates is thus carried on simultaneously on both sides of the cruiser, other workmen in the repair shop proper below decks can forge and shape new bars, plates and miscellaneous articles. All parts of the repair shop are kept busy in this way.

Should the navy craft prove all that is expected of it, there is little doubt that it would be the pioneer of the whole fleet of such floating repair shops for general commercial use. Their construction would not be confined to the shipbuilding plants of our few Atlantic ports, but one or more would be fitted up for every seaport of importance on the Great Lakes and on either coast. That there is need for such ships is quite evident, and modern designing of electrical and pneumatic tools and machines makes their construction practical. Such floating repair plants would have to be designed to do nearly all the ordinary repairing of a modern ocean liner, from replacing wrenched and loosened iron plates to erecting new smokestacks or fitting on a broken screw or shaft. Repairs below decks as well as on the superstructure would come within the province of the workmen. Portable tools, drills and punches that could be carried down below, and derive their power from the electric plant of the repair ship, would greatly simplify work on ordinary tramp and freight steamers. To be able to fit up a disabled steamer in this way without taking her out of commission would save thousands of dollars to her owners.

Electrical Apparatus for Measuring Speed.

An ingenious device for measuring speed is now employed by Lahmeyer & Company, Frankfort, Germany, for use on the locomotive supplied to the Royal Railway at Frankfort-on-the-Main. The apparatus depends for its action upon the change in impedance of an inductive circuit with the frequency. A transformer is arranged, upon which are three coils. Through one of these is passed a current which is drawn from the supply circuit. Through another is passed a current which is interrupted by a commutator driven from the axle of the locomotive. The third coil is attached to a voltmeter, the indications of which vary with the frequency of the interruption of the current, hence giving an indication of the speed.

NOTES ON THE USE OF RARE EARTHS IN ELECTRIC ILLUMINANTS.[1]

BY MURRAY C. BEEBE.

As scientists and engineers have come to a realization of the inefficiency of existing methods of illumination, the problem of improving upon these inefficient methods has received considerable attention. While the element carbon has, heretofore, been almost exclusively used commercially in both arc and incandescent lamps, the rare earth oxides, so called, have recently been found to possess desirable properties for use as illuminants.

We are already familiar with the work of Auer von Welsbach in producing gas mantles of thoria and ceria. To use the rare earths in electric illuminants was a logical step. However, the problem possessed difficulties not encountered in the production of a serviceable gas mantle. We should remember that an illuminant, to be an improvement over the Edison or carbon filament lamp in the matter of efficiency, must be capable of withstanding a higher temperature than the carbon filament for a length of time sufficient to make it commercially attractive. One might at first suppose that it would be difficult to improve upon the carbon filament in the matter of efficiency, or the ability of the filament to operate commercially at a very high temperature, since carbon is practically infusible and the rare earths are fusible. Carbon, however, slowly vaporizes at the temperature at which it operates in the incandescent lamp, and finally, after 400 to 600 hours, has depreciated in light-giving power to such an extent that it is best to replace it. It is the vaporizing properties rather than the melting points of the materials, with which we are concerned in this problem. It has long been known that substances which are commonly regarded as insulators, such as glass and porcelain, become quite good conductors of electricity at higher temperatures.

Professor Buff, in 1854, read a paper "On the Conductivity of Heated Glass for Electricity," and "Faraday's Researches," gives a number of examples of such conductors. Jablochkoff attempted to use refractory materials, such as lime, to separate and insulate the carbon electrodes of his Jablochkoff candle. He soon found that these supposed insulators in reality became conductors and emitted light by virtue of the current passing through them from one electrode to another. He even designed terminals with which to carry the current of electricity to the lime conductor, with the idea of making a lamp based on this principle. It is safe to say that were it possible to produce electricity as cheaply then as now lamps of the Nernst type would have been known commercially much sooner than they were, for Jablochkoff's persistent attempts at commercial exploitation were baffled largely by the undeveloped state of electrical engineering.

That the rare earth oxides are exceedingly refractory and do not readily vaporize at high temperatures makes the Welsbach mantle possible; that these oxides will conduct electricity when hot makes the Nernst lamp possible. Of all the oxides which conduct electricity but few are refractory enough for an efficient filament or glower. It was in determining the most desirable of these and in fixing the best proportions to use that Nernst did his greatest work.

Ordinary red iron oxide, when formed into filaments and baked, will conduct electricity at ordinary temperatures, but such filaments do not withstand sufficiently high temperatures to be used as light sources. Magnesia and thoria, on the other hand, withstand exceedingly high temperatures, but these conduct electricity only with great difficulty. In general, mixtures of two or more oxides conduct better than a single oxide, and, in turn, the fusing point of the mixture is lower than that of either oxide alone. It seems that the vaporizing point is not necessarily lowered, judging from the fact that thoria and the small amount of ceria used in a Welsbach mantle form quite a stable mixture, or possibly a chemical combination, while ceria alone or uncombined is a somewhat undesirable oxide from its rather marked tendency to vaporize.

It would be a long story to take up the various properties of all the rare earth oxides and the possible combinations with one or more of the others. A mixture which is used largely in lamps of the Nernst type is composed of eighty-five per cent zirconium oxide to fifteen per cent of yttria earths. Zirconium is not properly classified among the rare earths, though it is customary to do so. The term "yttria," as used here, means in reality a mixture of many oxides occurring together in certain minerals and closely allied in physical and chemical properties. Zirconia was used in comparatively large quantities for the first Welsbach mantles, and hence, considerable attention had been given to various methods of producing it for such use. While many of the experimental glowers were made from zirconia bought from chemical supply houses, it was impossible to obtain uniform results from such material. Good zircon ore, which is a zirconium silicate, occurs in abundance in Henderson County, North Carolina, and this ore contains about sixty-seven per cent of zirconium as oxide. By treating this ore in the following manner, quite uniform results are possible:

The ore is ground very fine in a ball mill and mixed with twice its weight of crude acid potassium fluoride. This is placed in an ordinary graphite crucible and heated slowly until thoroughly fused, and the ore is completely dissolved. The fused mass is then ground and dissolved in hot water containing a quantity of crude hydrofluoric acid equal to about one-tenth the weight of the fused mass. The silica remains undissolved as potassium silicofluoride (K_2SiFl_6) and the potassium zirconium fluoride (K_2ZrFl_6) is drained off while boiling hot into a silver-lined vessel. Upon cooling, the filtrate develops crystals of potassium zirconium fluoride, and, doubtless, small quantities of other elements in similar crystal form. Iron and many other impurities which are present in the ore, or have been introduced by the use of crude reagents, remain in the liquor which is drained from the crystals. The crystallizing process may be much hastened by artificial cooling. Rinsing the crystals with cold water is likewise beneficial in removing all traces of the mother liquor. The crystals are gathered and fused in a platinum dish. By this means, any silica present seems to be vaporized off, and other impurities, like titanium, are made insoluble. The fused mass is ground and dissolved in hot water and crystallized as before. A few of the first crystals are removed; or, instead, alcohol may be added to the solution until a small amount of crystalline precipitate is formed. These first crystals contain much of the undesirable impurities. They are, therefore, removed and the crystallizing process is continued. The pure crystals are then dissolved in hot water and the solution is made rather acid by the addition of pure hydrofluoric acid. Ammonia is now carefully added to the hot solution until a small amount of precipitate is formed. If the solution of crystals has been made acid, the addition of ammonia, even until alkaline, will precipitate out iron and some other foreign metals but will leave the zirconia in solution until it is cooled and diluted.

This method was found to be an exceedingly simple one for removing iron from zirconia, which, by other methods, is a troublesome operation. The hot filtrate,

[1] Paper read at meeting of the chemical section of the Engineers' Society of Western Pennsylvania, March 28, 1905.

after removing the precipitate of iron, is dropped directly into a cold ammonia solution which at once precipitates zirconia as a hydrate. Up to this stage of the process, it has been necessary to use vessels and utensils not affected by hydrofluoric acid. The last precipitate may be made in glass or wooden receptacles. The precipitate is washed several times by decantation, and then pressed out on suction filters and after a thorough drying by heat is powdered and sifted through fine bolting cloth and is then ignited in a platinum dish, over a very gradually increasing temperature and with constant stirring. The ignition process requires several hours, or sometimes days, the final temperature being a good red heat. Traces of silica are removed by this operation.

The physical condition of the precipitate is dependent to a great extent upon the amount of hydrofluoric acid in excess. When precipitated from an almost neutral solution, the precipitate dries into hard pieces translucent in appearance, and which are difficult to pulverize. With the greater excess of acid, the material dries in lumps resembling starch, in which condition it is much more suited to our purpose.

The zirconium made by this process seems to be reasonably pure. Precautions must be taken to keep out dirt, and to that end it has been found advantageous to purify the air admitted to the rooms where the glower materials are prepared by passing it through a water spray. An absolutely pure zirconia is not required and though a trace of silica improves the efficiency and seems to diminish the initial depreciation of candle-power of a glower, it is a dangerous element to have present, for slightly more than a trace will cause a rapid change in potential difference at the glower terminals besides causing lack of uniformity in the behavior of glowers of one batch, due to the fact that the silica becomes unevenly distributed among the glowers by vaporization and condensation occurring in a roasting process, which will be described later.

Although the purest materials make the best glowers for direct current, it can not be said that an absolutely pure zirconia is desirable for alternating-current glowers. Silica is particularly undesirable in direct-current glowers. In general, a glower which operates well on direct-current, showing almost no change in potential difference, will show a greater change when operated upon an alternating-current circuit.

The purity of the zirconia may be controlled, to some extent, by the number of times the material is crystallized during the purifying process, though each operation is attended with some loss of material. Physical properties are quite as important as chemical properties and the procedure above described was evolved to give proper physical, as well as chemical, properties to the material.

After all, "handsome is as handsome does"—and the real test for the glower material lies in its ability to make good glowers. Test glowers have been made from hundreds of lots of zirconia and these tests, together with careful chemical records of each lot, have been the guide in developing the chemical process necessary for the production of good glowers. For direct-current glowers, a crystallizing process is also considerably used, but from a solution of zirconia in hot dilute hydrochloric acid. After two or three such crystallizations, it is necessary to precipitate from a hydrofluoric acid solution, as in the first process, to get the material into proper physical shape.

As to the yttria used, this is principally obtained from the minerals gadolinite or yttrialite. Gadolinite is found in Norway and Sweden, and also in Llano County, Texas. The Texas deposit seems to be confined to a very small district and there is every evidence that it is a result of a volcanic eruption. It is found in crystalline form associated with yttrialite, crytolite, fergusonite, rowlandite, allanite and other minerals. The ores from the Llano County district are radioactive and the presence of a pocket in the quartz is generally indicated by bluish discolorations radiating from the pocket through some distance of the surrounding quartz. It is also claimed that the ores contain small quantities of confined helium gas. Gadolinite contains, roughly, 42 to 45 per cent of yttria earths, 23 per cent of silica, 13 per cent iron as oxide, and 9 to 12 per cent of beryllia. Yttrialite contains 43 to 47 per cent yttria earths, 30 per cent silica, 5 to 6 per cent ceria, didymia, and lanthan, as well as small percentages of urania. Fergusonite contains 32 to 42 per cent yttria earths, 32 to 46 per cent niobia. Rowlandite contains 47 to 62 per cent yttria earths, 26 per cent silica and small percentages of iron and magnesia. Allanite contains 26 per cent ceria and didymia, with a small percentage of yttria earths and considerable percentages of iron, calcia and alumina.

It is a comparatively simple matter to obtain and purify the yttria earths from gadolinite and yttrialite so that they are suitable for glower making. About one thousand grammes of ground ore are dissolved in crude aqua regia. The residue is filtered off and the solution evaporated to dryness, repeating this operation several times, or until all silica is removed. The neutral solution is then diluted to several litres and the addition of a hot solution of oxalic acid to the hot solution containing the earths, brings down the rare earths as oxalates, leaving iron and other impurities in solution. The oxalate is washed thoroughly with hot water and ignited, and the crude yttria earths are dissolved in dilute hydrochloric acid, just sufficient in amount to dissolve the oxide. To the rather dilute and neutral solution, which is cold, crystals of potassium sulphate are added in excess. After standing twenty-four hours, the cerium group has been quite thoroughly separated as double sulphates and the filtrate is then treated with ammonia to bring down the hydrates of the rare earths, thus freeing them of the great excess of potassium sulphate. The washed precipitate is dissolved in a quantity of pure hydrochloric acid just sufficient to dissolve it, and again treated with boiling oxalic acid solution, as before. This brings down the rare earth oxalates in sufficiently pure form. The oxalates are thoroughly washed with hot water and ignited, and any remaining potassium is separated from the ignited oxides by washing upon a filter with hot water.

With the yttria, as well as the zirconia, physical properties are important; and the oxalate method gives an exceedingly fine precipitate which requires no mechanical treatment.

Experiments indicate that the yttria earths of the greatest atomic weights give the most satisfactory results in glowers. In other words, ytterbia is better than yttria. Owing, however, to the great difficulty of separating the yttria earths from each other, which is so far possible only by laborious fractionation processes, entailing great losses, not much has been done toward using the higher atomic weight yttria earths beyond selecting ores which are rich in these earths.

The Llano County ores seem to be superior to the foreign ores in this respect, the atomic weights being

Yttrialite	115
Rowlandite	107
Fergusonite	103
Gadolinite	100

while the foreign ores may be as low as 90 or 92.

The zirconia and yttria earths mixed in the proportions given above; namely, about eighty-five and fifteen, or ninety and ten, and about five per cent of starch or gum tragacanth, are thoroughly mixed

and kneaded into a hard dough and squirted by pressure through a die of proper size. This string, as it may be called, is dried and then broken into suitable lengths which are roasted to an intense white heat in a platinum box. The pieces are then ready to have terminals placed upon them.

A Nernst terminal is made by winding stranded platinum wire about the end of the stick of material and then pasting over with a paste composed of ground glowers and zirconium chloride, thus forming a hard cement.

The Hanks terminal has the platinum embedded in the glower material, the operation being carried on by the aid of an electric arc in which the glower material is fused.

Certain it is that the mode of conducting the current is electrolytic in character. The specific resistance varies with the relative proportions of the constituents. In order to obtain glowers of the same specific resistance, when using yttria earths of high atomic weights, as when low atomic earths are used, it is necessary to have the presence of the higher atomic weight materials in proportion to the atomic weights.

Upon direct-current circuits, the positive end of a glower generally runs much hotter than the negative end, and a black discoloration appears at the negative end, especially if impurities are present. In fact, this is one of the most certain indications of the presence of an impurity.

A glower operated in vacuum soon destroys the vacuum, probably due to oxygen gas liberated by electrolytic action. That all the current is carried by electrolytic means seems incredible, for the current carried per square unit of cross-section is far greater than can easily be accounted for by our usual conceptions of electrolytic laws. For example—upon direct current and calculated by electrochemical equivalents, the entire glower would be decomposed into the constituent elements in a very few minutes. Doubtless electrolytic decomposition and recombination do take place, but is it possible to account for the entire transport of current in this way? The assumption that the current is all so carried seems unnecessary in view of what is known of the power of highly incandescent bodies to ionize air to render it conducting. The air in the neighborhood of a glower is conducting, and to such an extent that the leakage current from glower to heater had to be reckoned with early in the experimental work, and the difficulty was obviated by the use of a double-pole cutout which disconnected the heaters completely from electrical connection with the remainder of the lamp after the glower started.

In connection with these speculations as to the real nature of the process by which the current traverses the glower, it is a fact that glowers which have operated for even a short time upon direct current will, when the current strength is diminished sufficiently to maintain the glower at only a good red heat, explode with considerable violence. This may be accounted for by considering that the conductivity at low temperatures is insufficient to ionize the surrounding and contained gases. The means of conducting the current then being largely electrolytic in character, the combination of the products of electrolytic decomposition can not so readily take place, since the ions can not so readily traverse the length of the glower to combine at the lower temperature; consequently disruption occurs.

The suggestion that has so often been made; namely, that the current be reversed in direction at intervals, as, for instance, every time the lamp is started, is altogether impracticable for the reason that a glower once operated upon direct current must never have its poles reversed, for a reversal means almost instant disruption. The potential difference across the terminals of the glower immediately after such a reversal is lower, indicating something analogous to polarization effects as we know them in aqueous electrolytes.

In general, with the Nernst terminal, the potential difference across the glower at the normal current value is the same with alternating or direct current. With the Hanks terminal, or embedded type, the potential difference with direct current may be as much as twenty volts lower. The Hanks terminal will operate on direct current, but not satisfactory as a commercial proposition. The life of the alternating-current glowers is greater upon high frequencies than upon low frequencies, again suggesting electrolytic conductivity, at least in part.

The small glowers, up to 0.5 ampere, are made solid in cross-section, the largest ones are generally made tubular; and, in fact, one-ampere glowers must be made so. The reason for this is not that greater efficiency is sought by increasing the ratio of surface to volume, which is, of course, a fallacy, but inasmuch as the glower possesses a decided negative temperature coefficient as regards electrical conductivity, the centre of a large glower would become molten before the outside surface reached an efficient temperature, the centre being the better conductor. Glowers which have been greatly overrun, often exhibit this truth by the appearance of a nodule of molten material which has spurted out to the surface.

GLOWER IN VACUUM.

A glower will operate in vacuum but the vacuum rapidly deteriorates, as before stated. A blue aurora or luminous haze surrounds the glower thus operated, either with direct or alternating current, and has been thought to be due in some way to vaporized metal (zirconium or yttrium) recombining with the slight amount of oxygen liberated. This idea seems plausible from the facts that objects such as wire or glass near the glower become coated with a white deposit of the glower oxides in a comparatively short time.

It would seem that oxygen necessarily plays a part in conducting the current, for a glower in an atmosphere of hydrogen or nitrogen behaves similarly to the one operated in a vacuum. In carbon monoxide or dioxide the glower exhibits the same characteristics as in air. The glower operated in vacuum exhibits a peculiar sluggishness in responding to changes in voltage at its terminals.

A commercial glower must operate at a high temperature to be efficient. Nernst glowers operate at about 2,300 degrees centigrade, it is supposed from determinations made by photometric means, and at about twice the efficiency of a carbon incandescent lamp. The spectrum of a glower is a continuous one and no evidences of selective emission in any particular region are noted. During the life of a glower, which averages about 800 hours under normal conditions of manufacture and voltage regulation, a depreciation of candle-power takes place due to a number of causes. In the first place, all oxides of the rare earths do depreciate rather rapidly in light intensity per unit of surface at any given temperature. This is true even when heated by gas or electricity, and a platinum plate coated on one side with rare earths and heated from the rear by an ox-hydrogen flame behaves similarly. It is an inherent property of these oxides and a depreciation of ten or twenty per cent may occur during the first hour. There is then a slow diminuation of intensity of light, also inherent, and seemingly accompanying the tendency of the glower to change from an amorphous to a crystalline structure. A rise of potential difference across the glower terminals is usual, though it is possible to counteract this tendency, at least in part. The effect

of a rise in potential difference, obviously, is to diminish the intensity of light by permitting less current to traverse the glower, running on a constant potential circuit.

With carbon incandescent lamps, the useful life or smashing point is considered to be that number of lamp-hours during which the candle-power decreases twenty per cent from the initial candle-power. Nernst lamps are similarly rated, counting as initial candle-power that measured after the initial decrease above mentioned.

Other causes of depreciation in candle-power are blackening of the enclosing glassware and reflecting surfaces. In this connection, the blackening is due largely to platinum which has been vaporized and deposited upon these surfaces. It has been found that the purest platinum is far better than that containing iridium or other of the platinum group, since pure platinum vaporizes much more slowly than alloys with these other metals.

It is to produce uniform chemicals and glowers in which the tendency to depreciate in light intensity and increase in potential difference shall be a minimum, that makes the problem so intricate and so fascinating, and still capable of much improvement.

Curiously enough, not the least of the problems to be solved in the development of the Nernst lamp was to overcome the tendency of porcelains to conduct electricity, the very property which in the case of the rare earths made such a lamp as the Nernst possible. A heater is necessary to start the glower. The heater is made by winding fine platinum wire upon a porcelain tube. It was necessary to produce a suitable porcelain which would withstand the high temperature necessary, and at the same time not conduct electricity. A porcelain composed of kaolin, alumina and silica is sufficiently refractory and porous to withstand the heat, and is an almost perfect non-conductor at high temperatures. The porcelain piece upon which the glowers and heaters are mounted is also of the same composition.

Another form of heater used more abroad than in this country is helical in shape and the glower is mounted in its axis. This is made of pure kaolin and after squirting into tubes about a millimetre in diameter and winding with fine platinum wire and covering over the wire with a paste, the small tube is bent into a helix upon a mandrel, a pointed blow-pipe flame playing upon the kaolin tube at the point where it bends onto the mandrel.

POSSIBILITIES OF SELF-STARTING FILAMENTS.

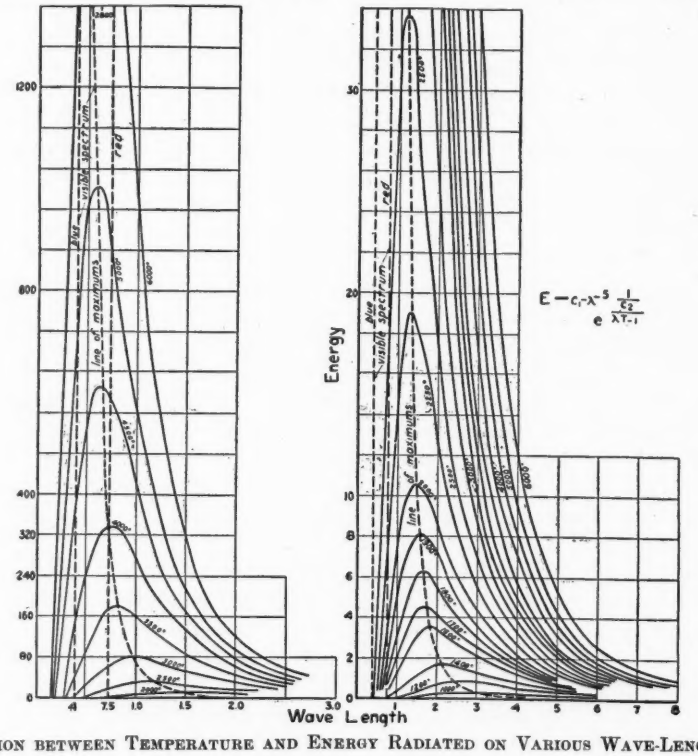
Many oxides will conduct at room temperature. A mixture of iron and tin oxides, about seventy iron to thirty tin, will start without preliminary heating and withstands rather a high temperature. There are many other similar combinations, likewise other possibilities exist; such as carbides, silicides and borides, operated either in vacuum or gases.

A Nernst glower may be made to conduct current at low temperatures by running it for a short time in a rarefied atmosphere containing a carbon gas. If to a globe in which a glower is operating in a good vacuum, an amount of hydrocarbon gas is admitted sufficient to lower the vacuum even less than a millimetre, the potential difference across the terminals of the glower will decrease rather rapidly and in the space of a few minutes, or even seconds, the glower will have become a conductor when cold; or, in other words, self-starting.

The following experiment was tried:

A glower was mounted in a glass bulb and in the axis of a carbon filament of a helical shape. The bulb was exhausted well and sealed off. The carbon filament was used four or five times to start the glower, alternating current being employed. After the glower had run a few hours, it was noted that it was changing color at its terminals. The discoloration gradually crept toward the centre and after about twenty-four hours the glower could then be started without preliminary heating. Apparently enough of the carbon filament was oxidized during the short time it was in use to give a slight quantity of free carbon monoxide in the bulb, the source of oxygen being the glower itself.

It is uncertain whether this gas was effective in reducing some of the glower material to its metallic form, or whether a conducting carbide was formed by the action of the carbon gas upon the glower materials. The former explanation seems preferable for the reason that it is noticed that the darkened portion at the negative end of direct-current glowers is of higher conductivity than the glower proper, and it seems quite likely that this deposit is a metal separated out by electrolytic action. Metallic zirconium, for example, withstands very high temperatures in the open air without oxidizing and its melting and vaporizing points where air is excluded must be very high.



RELATION BETWEEN TEMPERATURE AND ENERGY RADIATED ON VARIOUS WAVE-LENGTHS.

Many possibilities exist, such as are suggested by the above experiments, and many of them have been tried. Boron carbide, for example, withstands very high temperatures and is a conductor while cold, though it seems to vaporize somewhat too rapidly; at least this was the case with samples tried which probably were not very pure.

A Nernst glower, as well as those composed of thoria, magnesia and almost any

of the refractory oxides, may be made conducting by treatment with a hydrocarbon gas. Sodium and potassium vapor also effect a reduction to the self-starting condition, though not generally so readily as carbon.

There is a broad field still open and much that is not known of the properties of the rare metals. Oftener than not the supposedly pure metal is very impure, and the properties generally ascribed to it are in reality those of its carbide or other little known combination. Note the difference in properties of pure iron and iron containing even less than one per cent of carbon. Is it not a fact that almost nothing is known of the physical properties of the rare metals? A good example of this point, and one bearing directly on our subject, is the recently developed tantalum lamp, the filament of which is a fine thread of tantalum metal. Tantalum metal until recently was not known to possess properties which now make it a promising addition to electric illuminants.

More or less experimental work has been done, particularly in Europe, in using the rare earths in electric arcs with the idea of obtaining better efficiency and more pleasing light. Lamps have even been tried with electrodes composed entirely of the rare earth oxides, though at the present time the greatest advances in arc lighting are being made along the lines of introducing such elements as boron and tantalum into the electrodes.

In conclusion, attention is directed to a curve which has been plotted to show the relation between the temperature and the energy radiated in the various wavelengths of light for incandescent bodies. We are apparently at the present time just on the border of the possibilities.

BOOK REVIEWS.

"Mechanical Engineer's Reference Book." Henry Harrison Suplee. Philadelphia. J. B. Lippincott Company. Flexible leather. 859 pages. 4½ by 6¾ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $5.

This is the second edition of this engineer's reference book. It has been revised and enlarged, and such typographical errors as have been discovered in the first edition have been corrected. An appendix has been added, containing new matter, and the index has also been enlarged.

"Elements of Mechanics." Forty lessons for beginners in engineering, by Mansfield Merriman, professor of Civil Engineering, Lehigh University. New York. John Wiley & Sons. 12mo. 172 pages. Supplied by the ELECTRICAL REVIEW at $1.

The scope and purpose of this book is shown in the following extract from the preface: "the field of rational mechanics is so vast that no book can present more than a part of the same. Even the limited course usually given in engineering colleges is so difficult and appeals so little to the students' experience that few acquire a complete mastery of it. In the opinion of the author there should be given in every engineering college two courses in rational mechanics, an elementary one during the freshman year in which only as much mathematics is employed as is indispensably necessary, and an advanced one after the completion of the course in calculus. It is the principles and fundamental methods which are of the greatest value and importance, and if no course in mechanics is given until calculus has been completed, as is now generally the case, the student is introduced to a wilderness of algebraic matter in which these principles are largely obscured. Fortunately the fundamental elements can be presented without such advanced mathematics, and this book is an attempt in that direction. To read this volume with interest and profit, only a knowledge of plane geometry, elementary algebra, and plane trigonometry is required. It is intended for manual training schools, freshman classes in engineering colleges, and for young men in general who have the preparation just indicated." We heartily concur with the author's idea that the study of elementary mechanics should be begun in the freshman year. A large portion of the elementary course in mechanics requires only a knowledge of a few simple rules in arithmetic, the method of transposing simple algebraic equations and a few principles of plane geometry. With these as a foundation the young student of mechanics not only is put in possession of most of the important generalizations of the subject, but is also taught in the best manner to exercise his reasoning powers, including in addition to the mathematics his plain common-sense reasoning. We are gratified to notice that Professor Merriman begins the book with a discussion of force, and treats of such questions as the parallelogram of forces, couples, centre of gravity, friction and simple machines before he begins to treat of motion and velocity. This we think is the proper way to begin the study of mechanics and much easier to the student than the plan followed by many modern writers of beginning with motion and later treating of forces as something derived from the study of motion and acceleration. The subject of mass is not mentioned until the last chapter is reached and then it is defined not as the quantity of matter in a body but as the ratio W/G. "This ratio," says the author, "depends only upon the quantity of matter in a body and it is generally called 'mass' in higher works on theoretical mechanics, and is designated by M. The system of units used in this book is called the 'gravitation system' and is the one generally employed by civil, mechanical and mining engineers. The other system of units is of special value in celestial mechanics where bodies have no weight in the sense here employed." The author defines weight W to be the force with which gravity acts upon a body as determined by a spring balance. It would have been well also to have given a definition which is universally employed by engineers in practical work and which is used in common language, namely, that weight is the quantity of matter as determined by weighing it on an even balance or platform scale and thus comparing it with the quantity of matter in the standard pound. It is best to recognize the fact that the word weight in the English language and the corresponding word in all other modern languages is generally employed by the people at large in two senses; one as a measure of quantity of matter and the other as a measure of force, and the context always shows which meaning is used. The book is divided into forty lessons, of which six are comprised under the heading "Concurrent Forces;" six under "Parallel Forces;" five under "Centre of Gravity;" five under "Resistance and Work;" six under "Simple Machines;" six under "Gravity and Motion;" six under "Inertia and Rotation." Each of the forty articles has appended to it ten examples or practical problems, making 400 problems in all. The style of the author is in general clear and simple, but there are a few places in which the text is somewhat obscure. For instance, on page 8 the statement is made that "the 'component' of a force in a given direction is defined as a force represented on the given line of direction by the intercept included between normals drawn to it from the ends of the force-line." This is not clear and not true unless the two components are at right angles to each other. Some of the so-called axioms on page 11 are really not axioms and their truths should be demonstrated. Some of them appear to be true only under certain conditions.

The Legislative Enquiry on New York City Lighting.

For several weeks a legislative enquiry has been going on in the city of New York, looking into the production and cost of gas and electricity for public service. The Consolidated Gas Company and the New York Edison Company have been under fire for some time. A number of very interesting points were made when the investigating commission renewed its sessions on Thursday, April 6. Upon questioning Henry M. Edwards, auditor of the New York Edison Company, in an attempt to fix the actual values of all the properties employed in the business, it was developed that $7,500,000 of the power company's bonds was issued to acquire the eight small companies in the electric light business in Manhattan, the Bronx and Yonkers before the merger, and $21,000,000 for the Edison Illuminating Company, whose shares were paid for at the rate of 220. Mr. Edwards said that the illuminating company has earned sixteen per cent in 1899, 19.8 per cent in 1900, and for the first four months of 1901, or just prior to the consolidation, 10.6 per cent. In the twenty-eight months enumerated, a surplus has been accumulated amounting to $2,800,000.

In answer to a question as to the cost to the company of production and distribution, the witness said that, for 1900, it was 5.32 cents per kilowatt-hour, and for the first four months of 1901 it was 4.62 cents per kilowatt-hour. This was the operating cost, no allowances being made for depreciation, bad debts or interest on investment.

Mr. Edwards said that, in computing the cost of production and distribution, two calculations were made—one on the amount of current generated, and the other on the amount actually sold. He said that the difference was thirty per cent. In other words, the company was paid for about seventy per cent of the current produced at the stations. The cost of production in 1904, exclusive of depreciation, interest charges and the like, was, in Manhattan, 3.69 cents for current sold; in the Bronx, 2.98 cents, and in Yonkers, 5.10 cents. The average cost of production for current sold in the two boroughs was 3.66 cents per kilowatt-hour.

On Friday, April 7, Mr. Edwards stated that the corporation had earned some $10,000,000 in the last five years, after interest and expenses of all kinds had been paid, and that it had a surplus of $6,400,000 at the end of 1904. The other $4,000,000 was written off for depreciation.

On Saturday, April 8, Mr. Arthur Williams, general inspector of the Edison company, stated that thirty-four and one-half per cent of the Edison company's customers paid the highest rate—fifteen cents per kilowatt-hour, and that these consumers contributed forty-nine per cent of the total income. The average price was 12.27 cents per kilowatt-hour.

The sessions were resumed on Monday, April 10, when public lighting was taken up. Mr. Williams stated that the amount of current supplied to the city at the rate of twelve cents per kilowatt-hour during the year was 937,180.5 kilowatt-hours. Of this, 670,138 kilowatt-hours were paid for at the rate of twelve cents, making a total of $80,416.55. Four buildings had an exceptional rate. These were the Seventh Regiment Armory, which pays ten cents per kilowatt-hour; police headquarters, which pays 7.2 cents; the county clerk's office, which pays 6.7 cents, and fire headquarters, which pays 7.2 cents. The total receipts from these four buildings last year were $13,302.40. The number of incandescent lamps in the city's buildings aggregates 37,804. Mr. Williams stated that the company had private consumers who were using as much current in a single building.

Mr. John W. Lieb, Jr., vice-president and general manager of the New York Edison Company, testified that the company had in service about 45,000 meters. He said that the service for the city, taking into consideration the scattered condition of the plants, the additional cost for inspection and the valuation placed upon an equivalent power capacity for the maximum number of lamps installed, justified a charge of 11.36 cents per kilowatt-hour.

Concerning street lighting, the city has 3,995 arc lights. Of these, 1,127 are in the Bronx, and are fed from overhead wires, requiring 2,000 kilowatt-hours each per year. Those in Manhattan borough number 2,868. These are fed from underground circuits, and require 2,700 kilowatt-hours each per year.

On Wednesday, April 12, Mr. Edwards, auditor of the New York Edison Company, made a detailed statement showing the properties included in the company's capitalization when it was formed in 1901. The figures are as follows:

Property of Edison Electric Illuminating Company ($15,259,162.77) less 91,680 shares turned in and cancelled...	$6,091,162.77
Property of New York Gas and Electric Light, Heat and Power Company.....	66,545,100.77
Capital stock of power company taken in.....	9,040,000.09
406 shares Edison Illuminating stock, at $120,000, exchanged for bonds, which sold for.....	32,986.06
Total.....	$81,709,249.60
Now in treasury, 171.7 shares Edison Illuminating stock, which was exchanged for bonds, causing a deduction from the capital account of	20,604.00
Total.....	$81,688,645.60

Mr. John W. Lieb, Jr., stated that on Monday he had made an error in his estimate of the company's profit from the street lamps in Manhattan and the Bronx. Including all expenses, interest charges and depreciation, this profit should have been $95,000. A mistake was made when he said $115,000.

In reply to a question concerning the amount paid to the Consolidated Telegraph and Electrical Subway Company in 1904, Mr. Edwards stated that $210,000 was paid at the rate of $1,000 a mile for rental of a three-inch duct. He testified that the Edison company received from the Consolidated Telegraph and Electrical Subway Company for interest on securities owned in 1904 the sum of $268,650. The bonds guaranteed by the other duct corporation, the Empire City Subway Company, amounted to $250,000.

On Friday, April 14, the committee took up the examination of the acquirement of the United Electric Light, Heat and Power Company. This is usually spoken of as the power company in connection with the Consolidated Gas Company. The number of kilowatt-hours sold in 1904 was reckoned as 14,349,707. The average rate received from consumers was 9.44 cents per kilowatt-hour. The total amount realized was $1,355,774.01. The expenses were $1,232,530.83.

On Monday, April 17, the legislative commission continued its investigation. Charles E. Hughes, counsel for the committee, called upon Mr. Arthur W. Middleton, auditor of the Consolidated Telegraph and Electrical Subway Company, concerning the operating charges of the company. Mr. Middleton said that from 1894 to 1904, inclusive, the operating charges were $258,386.71. The franchise tax for 1904 was $68,754.66.

The week previous, upon the recommendation of several civic organizations in the borough of Brooklyn, an investigation was started concerning the operations of the public service corporations in that borough. Continuing the investigation, Mr. Hughes called upon W. W. Freeman, secretary and treasurer of the Kings County Electric Light and Power Company. Mr. Freeman testified that the surplus of the two allied Brooklyn electric light companies—the Kings County Electric Light, Heat and Power Company and the Brooklyn Edison Company—since 1898 was $1,071,834. He stated that the companies lived up to their contract with the city as to free lights in its entirety. The rate for service in Brooklyn until recently was higher than that for the service of the New York Edison Company in the borough of Manhattan. Prior to January 1, 1905, the gross charge was twenty cents per kilowatt-hour, with proportional discounts allowed. Since that date a schedule has been inaugurated, charging fifteen cents per kilowatt-hour for the first two hours, ten cents per kilowatt-hour for the third and fourth hours, seven and one-half cents per kilowatt-hour for the fifth and sixth hours, and five cents per kilowatt-hour for excess of that service. Under the new schedule, the income was twenty per cent less than the old. The company is producing more current, and at a less cost, than in 1904. The increase in the demand for current has been about six per cent. The average cost of arc lamps in the borough of Brooklyn is $115.32. In all, the Brooklyn companies serve 4,260 arc lamps, of which 3,100 are served from overhead lines.

THE MAGNETIC CLUB.

DINNER AT THE HOTEL ASTOR IN HONOR OF THOMAS A. EDISON.

One of the most interesting and entertaining events in the life of the Magnetic Club, now some seventeen years of age, was the one that occurred at the Hotel Astor on Thursday evening of last week. Thomas A. Edison was the guest of honor, and Colonel A. B. Chandler presided. In addition at the head table were F. P. Fish, president American Telephone and Telegraph Company; Colonel R. C. Clowry, president Western Union Telegraph Company; Clarence H. Mackay, president Postal Telegraph-Cable Company; U. N. Bethell, vice-president and general manager New York Telephone Company; the Hon. P. V. DeGraw, assistant postmaster-general; Walter P. Phillips, J. Merrihew, H. D. Estabrook, P. F. Murphy, W. D. Baldwin, Gardiner C. Sims, J. A. Van Wormer and E. C. Platt. The other tables were filled with guests to the number of three hundred, representative of the telephone, telegraph and electrical interests in general. Among others present were W. H. Baker, J. C. Barclay, C. P. Bruch, George T. Manson, James Kempster, Wm. Maver, Jr., W. L. Candee, M. R. Cockey, Frank Harrington, Theodore L. Cuyler, Jr., T. E. Fleming, G. H. Usher, W. H. Hawley (of Albany), Colonel C. A. Benton, E. B. Baker, Chas. W. Price, Captain Richmond P. Davis and George F. Porter.

The very excellent repast was followed by a number of interesting addresses by Mr. Fish, Mr. Estabrook, Mr. DeGraw, Mr. Murphy and Mr. Van Wormer. Colonel Chandler, as presiding officer, paid high tribute to Mr. Edison, and enumerated his inventions.

As he mentioned them one by one—the quadruplex telegraph, the telephone, the phonograph, the incandescent electric lamp—singers struck up appropriate tunes, the reference to the telephone, for example, serving to start them on "Hello, my baby; hello, my honey; hello, my ragtime girl." And as he was speaking of the electric lights every lamp in the room suddenly went out, leaving the table dimly lit by red-shaded candles, while the tenor sang the melody from the "Yankee Consul":

It was just like this in the olden days,
Which have passed beyond recall;
In the rare old, fair old, golden days,
It was just like this, that's all:
Then we studied hard by the candle light,
With our visions of future gold—
And some have realized all right
Since the days of old.

In his address, Mr. Fish gave Mr. Edison the credit for the invention of the word "hello" which he stated had been universally adopted and which was not covered by patent or copyright. A toast in silence was given in honor of Mr. E. C. Cockey, for several years president of the association, whose death occurred in this city a few weeks ago.

Mr. Edison appeared in the best of spirits and enjoyed most heartily the interesting way in which several of his leading inventions were honored in the proceedings. A reception was held at the close of the dinner, and Mr. Edison shook the hands of the great majority of those present, a number of the telegraph men being former associates of his.

The officers of the Magnetic Club are president, Colonel Albert B. Chandler; first vice-president, Marston R. Cockey; second vice-president, George H. Usher; third vice-president, David W. McAneeny; secretary, Frank J. Scherrer, and treasurer, Richard J. Murphy. Mr. T. A. Brooks is chairman of the entertainment committee, and Theo. L. Cuyler, Jr., is chairman of the reception committee.

National Electric Light Association.

Mr. Frank L. Perry, Marquette Building, Chicago, Ill., has been appointed assistant master of transportation for Chicago and adjacent territory, with the particular duty of working up a special train from Chicago to Denver-Colorado Springs, which will be run with a special train from New York for delegates to the convention of the National Electric Light Association, to be held at Denver and Colorado Springs, Col., June 6 to 11. Mr. George F. Porter is master of transportation.

As a result of the active campaign being carried on by Mr. Henry L. Doherty, committee on membership for the National Electric Light Association, several hundred names have already been added to the list of members since January 1.

The Franklin Institute.

The Franklin Institute, Philadelphia, Pa., announces the following section meetings: Thursday, April 27, 8 P. M., mechanical and engineering section, discussion, "Internal-Combustion Engines," opened by Professor H. W. Spangler; Thursday, May 4, 8 P. M., section of photography and microscopy, "Notes on Ultra-Violet Light in Photography and Microscopy," Dr. Henry Leffman, Philadelphia; Thursday, May 11, 8 P. M., section of physics and chemistry, "Some New Methods in Clinical Chemistry," by Dr. G. H. Meeker, Medico-Chirurgical College, Philadelphia, Pa.

THE INTERNATIONAL RAILWAY CONGRESS.

TO BE HELD AT WASHINGTON, D. C., MAY 3 TO 14, 1905.

The seventh session of the International Railway Congress will be held at Washington, D. C., May 3 to 14, 1905. The following programme has been announced:

April 29 to May 2, arrival of delegates.

Wednesday, May 3, from 11 A. M. to 2 P. M., registration of members of the congress. The office of the general secretary of the permanent commission will be at the New Willard Hotel, Washington.

Thursday, May 4, 11 A. M., formal opening of the congress. This will be held in the large banquet hall of the New Willard Hotel. Election of president and officers.

On Friday and Saturday, May 5 and 6, at 9.30 A. M. and 2 P. M., there will be meetings of the sections.

Sunday, May 7, will be given up to resting.

On Monday and Tuesday, May 8 and 9, at 9.30 A. M. and 2 P. M., there will be meetings of the sections. At 7.30 P. M. Tuesday, May 9, there will be a banquet given by the American Railway Association.

Wednesday, May 10, at 9.30 A. M. and 2 P. M., there will be meetings of the sections.

Thursday, May 11, there will be a meeting of the sections at 9.30 A. M. At 2 P. M. there will be a general meeting followed by a banquet.

Friday, May 12, 9.30 A. M., meeting of the sections. At 2 P. M., general meeting.

Saturday, May 13, at 9.30 A. M., meeting of the sections. At 2 P. M., general meeting and formal closing of the session.

Sunday, May 14, departure on tours of inspection which will be tendered to the foreign delegates. The exact itinerary of these tours and the hour of departure from Washington on the special trains will be announced later. The itinerary will be about as follows:

The Short Tour—Visits to Altoona, Pa., Pittsburg, Pa., Cleveland, Ohio, Buffalo, N. Y., Niagara Falls, Schenectady, N. Y., and Boston, Mass. This tour will occupy the time from the evening of Sunday, May 14, to the morning of Tuesday, May 23. The party will arrive on the return at New York. The total length of this trip is about 1,500 miles.

The Long Tour—Visits to Altoona, Pa., Pittsburg, Pa., Cincinnati, Ohio, St. Louis, Mo., Chicago, Ill., Buffalo, N. Y., including Niagara Falls, Montreal, Canada, and Schenectady and Saratoga, N. Y. This tour will occupy the time from the evening of Sunday, May 14, to the evening of Saturday, May 27, when the party will arrive on the return at New York. The total length of the trip is about 2,700 miles.

The Motor Drive for Machine Tools.

At the convention of the National Machine Tool Builders' Association, held in Washington, D. C., April 11 and 12, a discussion of the application of individual variable-speed motors for the driving of machine tools was taken up under the following headings: 1—advantages of the motor drive and the greater power necessary in the belt drive for machine tools; 2—relative cost of power for belt-driven and motor-driven machine shops; 3—standardization of motor drives.

Mr. G. Herbert Condict, vice-president of the Electro-Dynamic Company, Bayonne, N. Y., was invited to address the association on the above subjects, making the following points:

As to the advantage of the motor-driven tool over the belt drive, it was pointed out that, in the case of equipping a new shop, a saving could be made in the initial cost of the power plant. There will be less loss in the transmission of power from the engine to the shaft of the tool; therefore a smaller power plant would be required. It has been practically demonstrated that the average loss in the shafting and belting amounted to at least fifty per cent of the total power developed by the engine.

In the electrical transmission, assuming that the shop is to be operated at seventy-five per cent of the generator capacity, so that good efficiency can be obtained from the generator itself, the loss between the engine shaft and the line will be about six per cent; the line loss, two per cent, and the average loss in the motor itself, seventeen per cent. This is the provisional loss estimated in the adaptation of the "Interpole" motor. There will be a loss between the motor shaft and the shaft of the tool itself, where a single pair of gears or a chain drive is used, of five per cent, or a total loss between the engine shaft and the tool shaft of about twenty-eight per cent.

Attention was called to the fact that the loss in the shafting and belting is practically a constant loss, no matter whether the shop is operated at its full capacity or not. The loss in the case of the electrical transmission varies practically with the power used. Instances were given of a plant which had been entirely equipped with individual motor-driving, in which only one-half of the power capacity had been installed that had been calculated would be necessary in the case of the shop being designed for belt drive. This power plant had been operated on an average of only one-half of its capacity, thus showing that, in this particular case, only twenty-five per cent of the power was required for running the shop with electrical transmission that had been estimated on for belt transmission. Another case was given, in which it was desired to operate only a few tools in the shop, for which about twenty-five horse-power would be required; and a spare engine of about thirty-five horse-power capacity was started up to do the work. It was found that this engine would not turn over the shafting, and upon careful investigation of the entire power plant it was discovered that over fifty per cent of the power was consumed in the shafting alone.

As to the relative cost of the equipment of tools with individual motors and of their equipment with shafting and belting, it was impossible to arrive at any exact figures; but, provided the two-wire system should be adopted—as is the case with the "Interpole" motor—it was believed that the cost of electrical transmission would be much less than that of the belt and shafting transmission.

There would be no question that the motor drive would show a great saving over the belt and shaft driving in maintenance. Assuming that the electrical apparatus is made according to the most advanced methods of design, this will be particularly the case.

Replying to a statement made by one of the members of the association, that he had been unable to secure a variable-speed motor which would operate on a 500-volt circuit, Mr. Condict stated that the "Interpole" motor would operate on a 500-volt circuit as well as on a 110-volt circuit with high efficiency, and run sparkless even at a speed ratio of four to one.

Attention was called to the celerity with which speed changes could be made, and also to the fact that with these greater variations of speed the tool could be run at the most advantageous rate for any given work. There is also less opportunity for accident to operator or equipment, owing to the fact that there are no belts to throw on or off.

Reference was made to a case in which a department of a machine shop was being examined, where the bulk of the tools were driven from a line shaft. But one lathe was equipped with a variable-speed motor. A hot bearing occurred on the line shaft, and shut down all tools run by the shaft, and for twenty minutes twenty-three machinists were idle. On the other hand, the machinist on the motor-driven tool continued his work. As these shutdowns are liable to occur in the best regulated shop, from various defects and troubles of shafting and belts, this item of saving is quite an important one.

The statement was made that, in all probability, the equipment of a shop by shafting and belting will not be considered by future conventions of the Machine Tool Builders' Association, as there seems to be a desire on the part of both the machine shop men and the builders of machine tools to equip all tools, no matter of what capacity, with the individual motor drive. Incidentally, reference was made to the absence of dirt and non-interference with the lighting, which are features of the motor-driven shop.

The Automobile Parade.

The runs and tours committee of the Automobile Club of America has decided upon April 29 as the date for the annual run of the club in New York city.

The parade will form on lower Fifth avenue at 1.30 P. M., on the side streets, as follows:

Guest Division—Fifth avenue, east side, between Eighth and Ninth streets, Captain Homer W. Hedge, marshal. Pennant color: white and blue.

American Gasoline Touring Cars—Washington Square, east, Robert Lee Morrell, marshal. Pennant color: blue.

American Gasoline Runabouts—Ninth street, east, C. H. Gillette, marshal. Pennant color: red.

Foreign Gasoline Cars—Tenth street, east, E. T. Birdsall, marshal. Pennant color: yellow.

Steam Cars—Eleventh street, east, Augustus Post, marshal. Pennant color: white.

Electric Cars—Twelfth street, east, A. H. Whiting, marshal. Pennant color: green.

Automobile Clubs—Thirteenth street, east, A. R. Pardington, marshal. Pennant color: white and red.

The parade will start at 2.20 o'clock, promptly, from Washington square. The run will be up Fifth avenue to 110th street, thence across to Grant's tomb and Riverside drive, down Riverside drive to Seventy-second street and Broadway, where the parade will be disbanded between Sixty-fifth and Seventy-second streets. It is expected that fully 500 cars will be in line. The parade will not be confined exclusively to members of the Automobile Club of America.

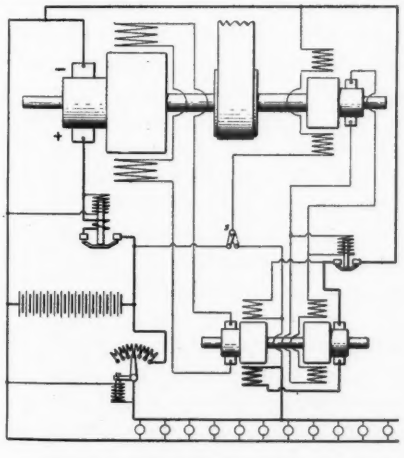
Panama Directors.

The United States government formally took over the property of the Panama Railroad Company on Monday, April 17, at the annual meeting of the stockholders, and the following directors were elected: Theodore P. Shonts, John F. Wallace, Charles J. Magoon, Mordecai T. Endicott, Peter C. Haines, B. H. Harrod, Oswald H. Ernst, William Nelson Cromwell, William Barclay Parsons, Clarence R. Edwards, J. R. De Obaldia, Rodger L. Farnham and Edward A. Drake.

Mr. Edwards is chief of the Bureau of Insular Affairs. Mr. De Obaldia is the Panama minister to Washington.

Electrical Patents.

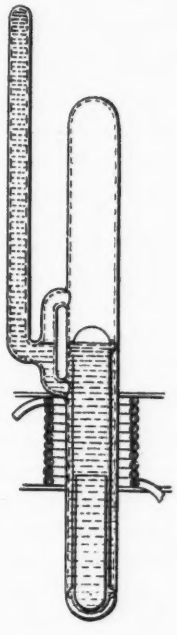
A system of electrical distribution is the invention of William A. Turbayne, of Lancaster, N. Y., and the patent obtained thereon (787,012, April 11, 1905) has been assigned to the Gould Coupler Company, of New York, N. Y. The invention relates to electric lighting systems in which the generating dynamo is subject to wide variations of speed and is liable to have its direction of rotation reversed —as, for instance, in railway-car lighting systems in which the dynamo is driven from one of the car axles. One object of the invention is to improve the self-regulating system of distribution with a view of producing the desired regulating effect for a given output by smaller and lighter machines and over a greatly wider range of speed variations. It is also the object to automatically reduce the generator output during the progress of the charge of the battery for preventing waste of energy and needless evaporation of the electrolyte after the battery has attained the charged condition. A battery is connected with a main generator, and an auxiliary dynamo has its field connected across the battery and varying in speed like the main generator. The auxiliary dynamo



System of Electrical Distribution.

controls a motor, which motor drives an exciter-dynamo, all arranged to vary the speed of the exciter-dynamo in an inverse sense to the speed of the main generator and to vary the excitation of the exciter-dynamo in an inverse sense to the speed of the main generator and to changes in the electromotive force of the battery.

David J. Steele and Charles Kratt, of Glasgow, Scotland, have patented in this country an improvement in electric recording instruments (787,005, April 11, 1905). The invention relates to electrical recording instruments of the type designed to record the maximum electric current which has passed through a circuit during an interval of time without being affected by those variations of current which are momentary or of short duration. It is the object of the invention to provide a convenient and reliable form of instrument which will be free from these defects and which can be so arranged that the maximum current is only registered after it has passed for a predetermined interval of time. In carrying out the invention the inventors employ a tube comprising a main arm containing a liquid, a secondary arm adapted to receive the overflow of liquid therefrom, and a restricted tubular communication between the main and secondary arm. An electromagnetic device surrounds a portion of the main arm, and a float in this main arm is adapted to be attracted by the electromagnetic device.



Electric Recording Instrument.

An invention relating to improvements in resistances, especially such as are heated by electric currents in apparatus, as rheostats, electric heaters, etc., has recently been patented by H. Ward Leonard, of Bronxville, N. Y. (787,047, April 11, 1905). In carrying out the invention, Mr. Leonard provides in a rheostat or electric heater a resistive conductor composed of an alloy containing nickel and copper, and having a relatively high coefficient of expansion, a relatively high-specific resistance and a relatively low-temperature coefficient. A support of insulating material for the conductor has a relatively low coefficient of expansion. An exposed terminal forms an electric joint with the resistive conductor. A coating of insulating heat-resisting material covers and surrounds the resistive conductor and the joint, the

Electric Resistance.

conductor being reflexed, whereby destructive strains in the coating is prevented when the resistive conductor is heated by the current.

New York Electrical Society.

The 250th meeting of the New York Electrical Society will be held at 19 West Forty-fourth street, Wednesday, April 26, at 8 P. M. Mr. N. J. Neall will lecture on "Lightning Protection for High-Voltage Circuits." The lecture will be a résumé of the development of lightning protection apparatus in America and abroad. A description will be given of the problems, their scientific character and bearing on the important question of lightning protection for high-voltage circuits, with a presentation of the favorable way in which these problems may be solved.

American Institute of Electrical Engineers.

The 196th meeting of the American Institute of Electrical Engineers will be held in the Chapter Room, Carnegie Hall, No. 154 West Fifty-seventh street, New York city, on Friday, April 28, 1905, at 8.15 P. M. The following papers will be presented and discussed:

"Polyphase Metering," by J. D. Nies, associate; instructor in Lewis Institute, Chicago, Ill.

"Notes on the Use of Instruments on Switchboards," by F. P. Cox, member; electrical engineer, General Electric Company, Lynn, Mass.

"The Oscillograph and Its Uses," by Lewis T. Robinson, associate; electrical engineer, General Electric Company, Schenectady, N. Y.

"Maintenance of Meters," by W. J. Mowbray, associate; electrical engineer, Brooklyn Edison Company, Brooklyn, N. Y.

Reviews of Current Engineering and Scientific Literature.

Small Electrical Generating Units Considered from the Point of View of the Economical Production of Electrical Energy.

A comparison is here made by M. R. Friederich of the different methods of driving small generators. The methods considered are gasoline engines, oil engines, producer-gas engines, gas engines using city gas, and steam engines using superheated or saturated steam. The conclusions are reached that the use of the gas engine or the oil engine becomes advantageous after the annual output reaches 2,700 kilowatt-hours. Above this point the advantage of the gas or oil engine increases rapidly. In any case, it is exceedingly important so to plan the plant as to reduce, as much as possible, the attention required. Frequently, the use of accumulators is not necessary, and when they can be avoided, the additional expense for the cost of maintenance and depreciation of the plant is greatly reduced.—*Translated and abstracted from La Revue Technique (Paris), March* 25.

Starting and Braking of Direct-Current Electric Motors by a Compound Rheostat.

The usual method of starting a direct-current motor by means of a rheostat inserted in series with the armature is criticised here by M. Emile Dubois. As usually installed, the series rheostat does not give a uniform acceleration, and when used for braking, the retardation is apt to be too sudden just before stopping. To avoid this, the compound rheostat has been devised. This is a rheostat somewhat larger than usual, and, when in use, is connected in parallel across the supply circuits. One end of the motor is connected to one side of the circuit, and the other is connected to points along the starting rheostat, so that the latter acts somewhat as a potentiometer resistance. When the rheostat is properly designed, the operator not only has control of the speed of his motor, but the current through the latter is limited to a definite value. The method of computing the resistances is given in full, and applied to an example. In this example the normal current of the motor is twenty amperes. The maximum current which is allowed to flow through at any time is about thirty amperes. The voltage of the supply is 110, and the normal speed of the motor is 1,500 revolutions per minute. The rheostat is designed so that the maximum current which will flow through it is one and one-half times the normal current taken by the motor. The first step in starting gives the motor a speed of seventy-two turns per minute. The second brings it up to 290 turns per minute. There are four additional steps before the motor attains full speed. When it is desired to stop the motor, the rheostat arm is thrown back to the next to the last notch. The speed at once drops to seventy-two revolutions per minute, and upon the last notch the armature is immediately arrested, since it is short-circuited, and the field strength is full.—*Translated and abstracted from L'Industrie Electrique (Paris), March* 25.

The Electrical Manufacture of Light and the Lamp of the Future.

In this article Dr. J. A. Fleming discusses the different electrical devices which are employed for producing light. He points out the imperfect state of our knowledge with regard to the production of light, and lays emphasis upon the necessity of a reform in the nomenclature and modes of reckoning the efficiency of electric lamps, as well as some more precise and scientific method of defining what it is we produce. The author describes some of the recent work in measuring the output of electric lamps, refers briefly to the amount of illumination found to be satisfactory, and gives the following picture of what the lamp of the future will be: in a highly exhausted bulb will be placed a small sphere of some substance—he knows not what—which phosphoresces intensely under electronic bombardment. On each side, and slightly above this ball, will be a metal saucer-shaped disc, which will be connected by sealed-in platinum wires to the terminals of the lamp. To these will be supplied, in some way, a high-frequency alternating current, which will create a storm of bombarding electrons, and the phosphorescent mass will glow intensely with a brilliant white, but perfectly cold light. The lamp will give what is called sixteen candle-power, with an energy absorption of five or ten watts, instead of fifty or sixty as at present. It will emit no radiation, except that which can affect the eye. The author is not able to provide details or to say how the high-frequency currents will be generated, or the form of wiring which will be utilized. He says that he is merely giving rein to the imagination in looking forward to discover the ideal form of illumination. He adds that invention has necessarily to move slowly when once large capital is invested in one particular form of manufacture. Long before the state of phosphorescent lighting is reached, we shall, no doubt, pass through other stages of thermo-lighting, by which is meant the process of producing light by heating some material.—*Abstracted from the Electrical Magazine (London), March* 25.

Electricity from Water Power versus Gas.

That gas is falling behind in competition with electrical energy generated from waterfalls is the belief of Mr. Alton D. Adams, and he here deduces figures which show why this should be so. At the greatest American centres of transmitted energy—San Francisco, Buffalo and Montreal—the net price of illuminating gas is about one dollar per 1,000 cubic feet, which is as low as such gas is usually sold anywhere in America. In spite of this low rate for gas, the sale of electrical energy from distant waterfalls has risen, during five years, to about 10,000 horsepower in San Francisco, more than 20,000 in Buffalo, and nearly 30,000 in Montreal. These figures do not merely represent the results of substituting water power for steam power at electric generating stations, but correspond, in large part, to increased loads on the electric supply systems. Whatever have been the changes in the volumes of gas distributed in these three cities, it is safe to assume that they can show no such increase as that just indicated for electricity from water power—a conclusion which is supported by the fact that at Montreal the gas output increased only six per cent during the twelve months ending with April 30, 1904. Comparing the gas light with the electric lamp, Mr. Adams finds that the cost of a sixteen-candle-power flame, with gas at one dollar per 1,000 cubic feet, is one-half cent per hour. In many places supplied from hydraulic electric plants, the rates for energy used in lighting are less than ten cents per kilowatt-hour, but even at this rate the cost of operating a standard fifty-watt sixteen-candle-power incandescent lamp is only one-half cent per hour. Thus, the electric light costs the same as gas, but gives, in addition, all its peculiar advantages. The use of mantle burners considerably increases the efficiency of the gas light, but, in spite of this, it has not made much headway against the electric

lamp. Comparing the two kinds of energy for heating, Mr. Adams finds that, at the rate of one dollar per 1,000 cubic feet of gas, 325 heat units are obtained for one-tenth of a cent. This figure allows for a loss of fifty per cent, due principally to the heat carried away by the products of combustion. With an electric heater, there is no loss. A kilowatt-hour corresponds to 3,438 heat units. For various reasons, electrical energy is not infrequently supplied for heating purposes at a rate as low as one cent per kilowatt-hour, which gives 343 heat units for one-tenth of a cent. In some cases the rate for electrical energy for heating is as low as one-half cent per kilowatt-hour, which gives twice as many heat units as gas at the same cost. Returning to the question of power production, Mr. Adams finds that a good gas engine, at nearly full load, will develop one horse-power-hour for two cents at the regular rate for gas of one dollar per 1,000 cubic feet. At partial loads the efficiency of the gas engine falls rapidly, and the cost of its power rises. As electrical energy from water power is frequently sold as low as one cent per kilowatt-hour for motive purposes, it is no wonder that successful competition of gas engines is difficult under such conditions.—*Abstracted from Cassier's Magazine (New York), April.*

An Electrostatic Voltmeter for High Potentials.

Various methods have been used for measuring high voltages. These may be satisfactory if the potential be not too high, but when it goes above 20,000 volts or so, difficulty is encountered in many of the types of apparatus employed. A transformer inserted in the high-voltage circuit is satisfactory if one can be sure that no leakage occurs. Non-inductive resistances used as multipliers are also good if there is no doubt of their non-inductiveness. Condensers connected in series across the circuit, used as multipliers, have been successful, but difficulty is encountered in adapting the instrument to different frequencies, because it is not easy to construct an instrument having the same dielectric coefficient as the condensers. None of these methods seemed to Herr A. Grau satisfactory, and he has therefore constructed an instrument of a different type, which enables him to measure, with fair accuracy, voltages up to 90,000. This is an electrostatic instrument constructed in the following way: a glass jar forms the case, and is filled with a good quality of oil, to serve as the dielectric. At the bottom of the jar is a glass plate resting on three legs. This plate supports a metallic cylinder which forms one plate of the voltmeter. Connection to this cylinder is made by means of a fine wire carried down through the oil in a long porcelain tube. Concentric with this cylinder is a smaller cylinder suspended by means of a copper wire surrounded by a glass tube. To the bottom of this small cylinder is attached first a thin plate, and below this plate a lead weight. Projecting from the weight is a glass rod, which holds the movable system concentric with the large fixed cylinder. This whole system is suspended by means of a fine wire running over a pulley, with a counterweight on the other end. A pointer is attached to the pulley, which multiplies the motion of the movable cylinder, indicating it on a suitable scale. To the pulley is attached a small weight, adjustable so as to vary the sensitiveness of the device. The movable system is, of course, connected to the other side of the high-voltage circuit, the wire being led to the pulley through a porcelain tube. The plate attached to the lower part of the small movable cylinder serves to damp the motion of the latter. The glass rod which holds this system concentric is kept in place by means of three friction rolls attached to the glass plate mentioned above, the rod passing through a hole in the plate. This instrument does not give a uniform scale, as the latter is a little more open at the centre than near the ends. The particular instrument here illustrated is suitable for 90,000 volts only, as above this voltage a discharge passes from plate to plate through the oil. The following are the principal dimensions of this instrument: the large cylinder is twenty centimetres in diameter and fourteen centimetres high. The small movable cylinder placed in the centre is three centimetres in diameter and eleven centimetres long. The lead weight attached to it weighs 200 grammes. The capacity of this instrument was about one-ten-thousandth of a microfarad.—*Translated and abstracted from the Electrotechnische Zeitschrift (Berlin), March 23.*

Electrolytic Detectors of Electric Waves.

A study has been made by M. R. de Valbreuze of the different investigations into the action of the electrolytic detectors employed in wireless telegraphy. In principle, the apparatus consists of an electrolyzer in which an extremely fine platinum wire serves as the anode, and a larger platinum wire as the cathode. Any solution seems to serve, although certain investigators prefer an alkaline solution. Schloemilch gives the following generalization: all electrolyzers with electrodes of gold or silver, immersed in dilute sulphuric acid and submitted to a difference of potential slightly greater than the counter-electromotive force of the cell, so that a small current traverses it, producing at the electrodes a slight disengagement of gas, show a very clear increase in the current when submitted to the action of electric waves of high frequency. This conclusion has been verified by Dieckmann, but he used for his electrodes two metals somewhat separated in the electrochemical series—a construction which made the use of an auxiliary battery unnecessary. His apparatus consisted of a glass vessel containing at the bottom a concentrated solution of copper sulphate, and at the top a dilute solution of sodium chloride. The cathode was formed of a strip of zinc-foil, and was placed in the solution of sodium chloride. The anode was a fine copper wire, the lower portion of which only came in contact with the liquid. The electric circuit contained this detector, a high resistance and a galvanometer. The electrodes were connected together through condensers to the secondary of a small induction coil. When the anode was inserted into the solution of sodium chloride, the galvanometer indicated the passage of 0.000022 ampere. When the induction coil was set in action, the current was increased to 0.00048 ampere. On the contrary, when the anode was plunged into the solution of copper sulphate, where no polarization was possible, the current passing without the coil in action was 0.000613 ampere, and this fell slowly to 0.0004 ampere when the coil was put into operation. According to the position of the anode, the element acts either as a coherer or an anti-coherer. It has been stated by some investigators that there is nothing gained by earthing the receiver. On the other hand, Rothmund and Lessing have found that there is a decided advantage in earthing the receiver and the transmitter. These investigators have also studied the action of the device above the point of decomposition, and they have found a relatively considerable increase of the current in that region. They find that for voltages above four it is necessary for the anode to be the small electrode. For lower voltages the phenomena are identical, whether the small electrode is anode or cathode, though in the latter case the action is more feeble. Neither the chemical nature of the products of decomposition nor the constitution of the electrodes has any effect on the phenomena. The general results of these investigations seem to show that the action depends upon the phenomena of polarization. The author believes that investigations have not yet been sufficiently complete to determine this point finally.—*Translated and abstracted from L'Éclairage Électrique (Paris), March 25.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

An Apparatus for Automatically Transcribing Morse Signals.

The accompanying illustrations show a recently developed type of apparatus for printing Morse messages in English or other characters on a strip of tape, in a manner similar to that of the familiar stock ticker. No special apparatus is required for sending the messages other than the regular Morse key in the hands of an ordinary skilled Morse operator. In the present instrument it is necessary to use a synchronizing device to keep the sending and the receiving apparatus in unison. There are no vibrating rods or other sensitive parts, and the mechanism is comparatively simple. The instrument operates on the principle of analysis and synthesis, the analytical portion measuring the length of the impulses, as well as their respective positions in the character being sent over the line. The synthetic portion turns the type wheel to the position corresponding to the value of the combination of impulses representing each character. Should one character be missent, it will have no influence over the following character, as the mechanism starts from zero for each character.

The inventor, Charles R. Underhill, New York city, states that this apparatus may be almost instantly attached to any Morse telegraph line, and the messages will then be printed in English on the tape, instead of being recorded in the

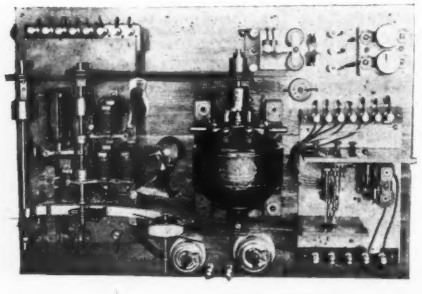


FIG. 1.—APPARATUS FOR TRANSCRIBING MORSE SIGNALS, CONNECTED TO WIRELESS TELEGRAPH APPARATUS.

form of dots and dashes, or being received by ear and translated by the operator. At the same time, the regular Morse instrument will operate as usual, since the line conditions have not been disturbed.

The instrument shown in Fig. 1, when connected in the local circuit of a wireless telegraphic outfit, recorded the wireless messages in printed English. The instrument shown in Fig. 2 is a more recent type, and is more rapid in operation. This machine would give excellent results when

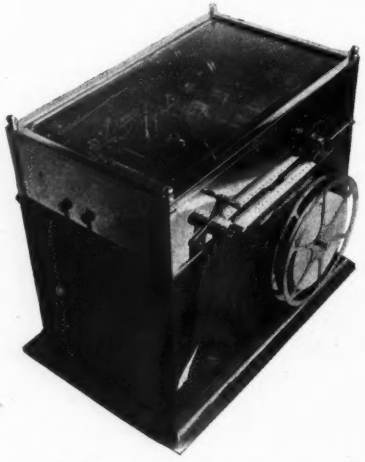


FIG. 2.—RECENT TYPE OF APPARATUS FOR TRANSCRIBING MORSE SIGNALS.

connected on a line with the well-known Morse transmitting typewriter.

Construction of Telephone Systems.

The telephone construction season has opened auspiciously for the Automatic Electric Company, Chicago, Ill., which closed four contracts for new automatic telephone plants during the month of March, besides several contracts for additional equipment for exchanges already built.

The latest contract is for a complete system of 1,500 lines for the Southern Independent Telephone Company, of El Paso, Tex. For this company the Automatic Electric Company is to build and install a complete central office equipment having an immediate capacity of 1,500 lines and an ultimate capacity of 10,000 lines.

The switchboard will be the regular standard type consisting of fifteen units, each unit carrying the necessary switches for handling 100 lines. Five additional units will be installed partially in blank so that the plant may be increased to 2,000 subscribers by simply adding the additional shelves. The cross-connecting frame will be F. B. Cook's latest type with self-soldering heat coils.

The power plant will consist of duplicate sets of storage batteries of the American Battery Company's manufacture. Two charging outfits will be furnished, one of which will be a Holtzer-Cabot motor-generator, the motor being designed to be run by the commercial power circuit; the other charging outfit will consist of a Fairbanks-Morse vertical gasoline engine belted to a charging generator. Two ringing machines will be included, one of these will be a motor-generator outfit designed to be run on the commercial power circuit; the other will be a dynamotor wound to be run on the exchange storage battery. Both machines will be Holtzer-Cabot make and will have the customary busy and howler attachments.

The power board will be of pink Tennessee marble bolted to an iron framework. On it will be mounted switches and fuses for regulating and protecting the circuits of the power plant, an overload and underload circuit-breaker for the charging circuit, a Weston ammeter and voltmeter, field regulators for the charging machines, etc.

The entire automatic equipment and power plant is to be installed in one large commodious room, and, in addition to this, the Automatic Electric Company will put in this same room a two-position wire chief's and trouble clerk's desk. In the offices of the company will be installed a two-position information and toll operator's desk. The trouble clerk's position of the wire chief's desk will be arranged so that all of the toll and information trunks and lines can be switched to it at night.

The Automatic Electric Company is now building or installing public exchanges for Los Angeles, Cal. (3,000 lines in addition to the 6,700-line automatic exchange already completed, making 9,700 lines in all); San Diego, Cal.; Columbus, Ohio (8,000 lines); Sioux City, Iowa; Hastings, Nebraska; South Bend, Ind.; Wausau, Wis., and El Paso, Tex., and private exchanges for the Milwaukee Electric Railway and Light Company, Milwaukee, Wis.; the New York Manufacturing Company, Saco, Me.; Frankford Arsenal (Ordnance Department, U. S. A.), Bridesburg, Pa.; and Springfield Arsenal (Ordnance Department, U. S. A.), Springfield, Mass.

These last will make five automatic telephone exchanges that the United States government has purchased of the Automatic Electric Company, four for the Ordnance Department of the Army (at the arsenals named and at Rock Island Arsenal, Rock Island, Ill., and Watervliet Arsenal, Syracuse, N. Y.); and one by the Navy Department for the United States naval station at New Orleans, La.

Alternating-Current Ceiling Fans.

The Hunter Fan and Motor Company, Fulton, N. Y., in presenting its line of alternating-current ceiling fans for 1905, has added two types to its already popular list.

Fig. 1 shows the "Tuerk" alternating-current ceiling fan. This is the same fan that the company has been making for years, and it has given great satisfaction. It is so arranged that the blades can be set at any angle while running, and is furnished for all cycles and voltages, and with either two or four blades. If desired, the "Tuerk" fan may be furnished without the blade adjuster. These fans have the same sweep of blades as the regular fan, the same speed, and consume the same amount of current.

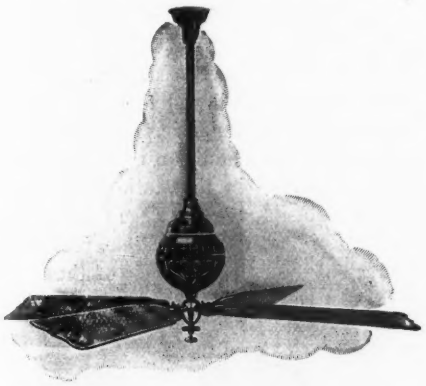


FIG. 1.—"TUERK" ALTERNATING-CURRENT CEILING FAN.

Fig. 2 shows the "Hunter" fan for 1905. Several new features have been added, improving the design, efficiency and operation. The "Hunter" fan has a speed of 175 revolutions per minute, carrying two or four blades of sixty-inch spread and width of eight inches at a maximum current consumption of 110 watts. It is equipped with a two-speed regulator and starting switch placed at the bottom and so arranged that any fan can be made into an electrolier. The "Hunter" fan is supplied for forty, fifty and sixty cycles only, and voltages from 50 to 220.

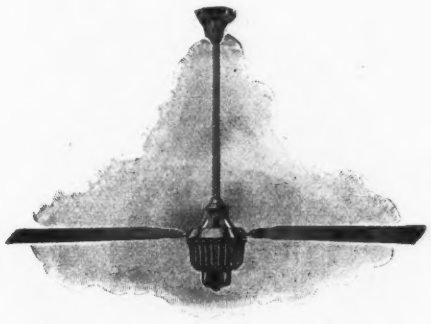


FIG. 2.—"HUNTER" CEILING FAN.

Fig. 3 shows the "Hunter" fan so constructed that the electrolier attachment can be made by simply removing the plugs at the side of the switch case, and replacing them with curved electric fixture nipples for holding the sockets and shades. They are wired with an independent lighting circuit, so that the lights and fan are independent of each other. They are made so that two or four lights can be used. The company will furnish the necessary angles, sockets, etc., when required.

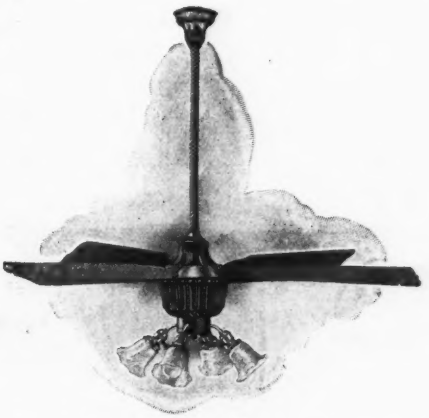


FIG. 3.—"HUNTER" FAN WITH ELECTROLIER.

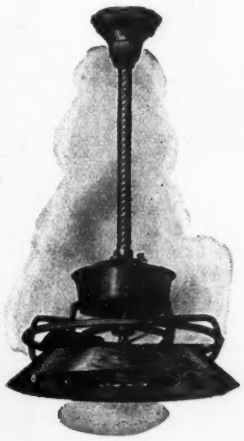


FIG. 4.—"FULTON" DEFLECTOR CEILING FAN.

FIG. 5.—"FULTON" DEFLECTOR FAN WITH ELECTROLIER.

Fig. 4 shows the "Fulton" deflector ceiling fan. The motor is of the well-known induction type, and the fan is equipped with special blades of fourteen-inch sweep, set at an angle of twenty-eight degrees, and running at two speeds —1,050 and 800 revolutions per minute —with a maximum current consumption of 125 watts. The air is delivered on to three discs or stationary deflectors which distribute it equally over a large area. It is said to be practically noiseless, and is well suited for use in private dining-rooms, over billiard tables, or any place where fans with wooden blades can be used, or where long blades are objectionable. This fan will be supplied for voltages from 50 to 220, and on systems of from 40 to 140 cycles. The fan is also made up as an electrolier fan, an illustration of which is shown in Fig. 5.

The eastern agents for the Hunter Fan and Motor Company are E. B. Latham & Company, 39 Vesey street, New York city.

Extensive Additions to the Allis-Chalmers Milwaukee Works.

The Allis-Chalmers Company, Milwaukee, Wis., on April 8 decided to begin immediately a $3,000,000 extension to its Milwaukee works, for the manufacture of electrical machinery of all kinds, of the largest types, and for construction of steam turbines, hydraulic turbines and gas engines. Three large buildings will be erected, and two of the existing buildings extended.

The electrical department at Milwaukee will be operated in connection with the plant of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, which is owned by the Allis-Chalmers Company.

The importance of this project in connection with the great development of electrical engineering which is taking place everywhere is a matter of unusual interest. This will provide in the West one of the largest engineering establishments in the world, centering under one organization the design and construction of all classes of prime movers and auxiliary power apparatus.

Westinghouse Choke Coils.

Lightning arresters are employed to relieve the line of abnormal rises of potential due chiefly to static disturbances, while it is the function of choke coils to prevent such disturbances from entering the apparatus which they protect. The choke coil operates on the principle that a coiled conductor presents a greater resistance to the passage of an electric current of high frequency than to one of relatively low frequency; therefore, though a coil may have a very slight resistance to direct current or to alternating current of from 3,000 to 7,200

FIG. 1.—LOW-VOLTAGE CHOKE COIL FOR RAILWAY WORK.

alternations, its resistance to lightning discharges or other static disturbances, which always occur very suddenly, may be very great.

In order that the choke coil may perform its duty successfully, very great care must be exercised both in its construction and in its installation. The Westinghouse Electric and Manufacturing Company has for the past twelve years been engaged in the manufacture of choke coils and the development of protective appli-

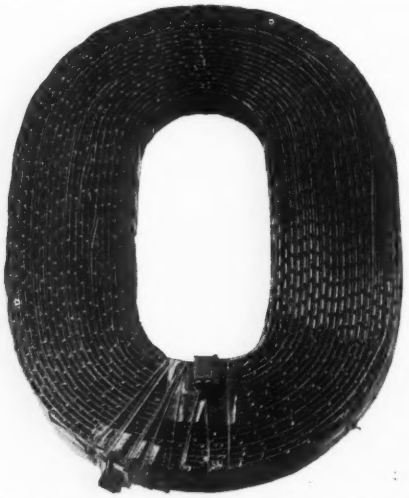


FIG. 2.—DISC FORM OF CHOKE COIL FOR ALTERNATING CURRENTS.

ances for circuits of both high and low potential.

For low voltage circuits, such as railway work, the form illustrated in Fig. 1 has been developed. The conductor is coiled in the form of a cylinder and is mounted on a wooden spool, each turn being insulated from its neighbor and the completed coil skillfully protected from moisture and dampness. The lightning arrester is connected to a terminal plate laid across a few turns of the line end to provide a selective path to earth.

In alternating-current work, a disc form of coil has been found to give the best

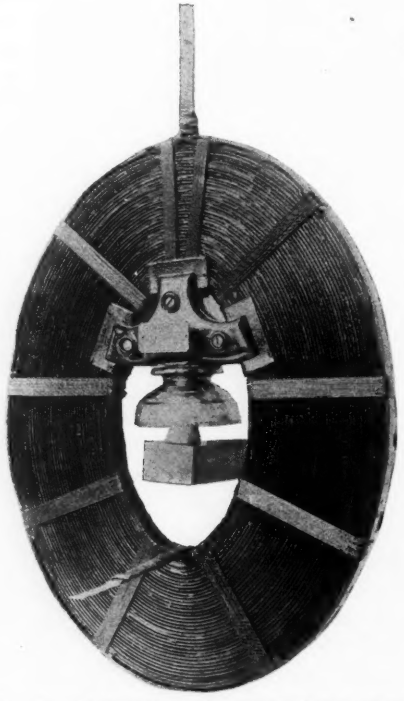


FIG. 3.—ALTERNATING-CURRENT CHOKE COIL MOUNTED ON INSULATOR.

protection. A form of this coil is shown in Fig. 2. The insulation of these disc-form choke coils, which are known as the Westinghouse type 7, has great dielectric strength and extends beyond the sides of the conductor, so that there is little likelihood of the discharge jumping from terminal to terminal or from layer to layer. The coils are constructed with a large factor of safety. Very large cooling surfaces are provided. As the coils are wound with but one turn per layer, every turn is exposed on two sides and offers a maximum radiating surface to the cooling influence of the surrounding air.

As these coils are connected in the line, it is desirable to mount them on insulators capable of withstanding the line voltage. The coils must also be held securely against the side pull due to magnetic action. To meet these conditions the support illustrated in Fig. 4 has been developed. It is very strong and the insulator which accompanies it has given excellent service at the voltages for which choke coils of this type are designed.

Coils of this type vary in the size of the conductor and in the number of turns, depending upon the current and voltage of the apparatus which they are intended to protect. They are manufactured in a great many different capacities, ranging from 7 to 200 amperes and from 2,500 to 25,000 volts, inclusive. Coils of the same type have been successfully used for the protection of apparatus with a potential lower than 2,500 volts, where the conditions are such as to require protective devices of this form.

For apparatus with potentials higher than 25,000 volts, two forms of choke coils have been developed, *viz.*, the oil-immersed choke coil and the static interrupter. Oil immersion improves the insulation, while the addition of a condenser such as is used in the static interrupter makes it possible to reduce the relative size of the coil, at the same time providing increased protection. Either of these devices can be made to afford effective pro-

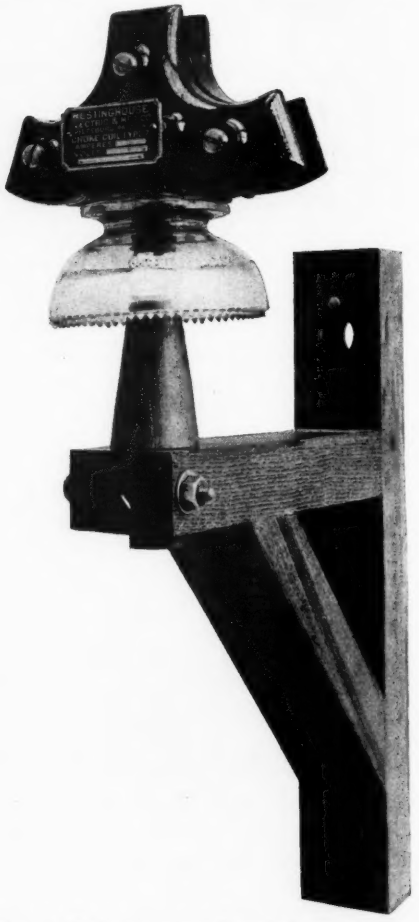


FIG. 4.—INSULATOR AND SUPPORT FOR ALTERNATING-CURRENT CHOKE COIL.

tection against powerful disturbances. Both are immersed in oil and can be either of the self-cooling or water-cooled type. The oil-immersed choke coil is mounted on a wooden frame and is ventilated in such a way as to maintain a temperature uniform in every part. The ventilating ducts when filled with oil add

greatly to the insulation between layers, and are so arranged as to promote a natural circulation of oil around the coil. The cases in which these coils are mounted in general resemble those standard for Westinghouse transformers. They are constructed with the greatest care and include fibre tubes designed to protect and insulate the leads.

The "Economy" Switch.

The accompanying illustration shows the "Economy" switch, manufactured by the Seidler-Miner Electric Company, 207-211 Jefferson avenue, Detroit, Mich. The "Economy" switch is designed to increase

THE "ECONOMY" SWITCH.

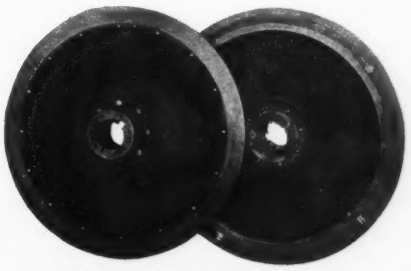
the life and use of primary batteries. It is substantially constructed, and the company states that if used according to its directions, it will more than double the life of the batteries. In operation, the first point switches on one set of batteries. The second point switches a second set of batteries. The third point switches both sets in multiple series, and the fourth or last point switches the two sets of batteries in series. By using the third point, or multiple connection, on a new set of batteries, it is stated that one-third more capacity will be secured than by using the cells singly, or first one set and then the other. When the engine starts to miss on the third, or multiple, connection, the batteries have dropped from 1.4 volts to 0.75 volt per cell. By moving the lever on the last, or series, connection, the operation of the engine may be continued, getting from one-third to one-quarter more capacity out of the batteries than when operating them in single sets.

Motor Omnibuses and Tram Cars in England.

At a recent meeting of the highways committee of the London County Council, the chairman stated that the cost of running motor omnibuses carrying thirty-four passengers was from twenty-two to twenty-four cents per car-mile, while that for electric tram cars carrying from fifty to seventy passengers was but ten to twelve cents per car-mile.

Magnetic Couplings and Accelerators.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has been carrying on experiments for several years in the development of magnetic couplings and accelerators. The Cutler-Hammer



PARTS OF MAGNETIC COUPLING.

Clutch Company has now been organized for the manufacture and sale of this apparatus, and it announces that it has designs and equipment for the manufacture

FIELD IN THE ROUGH.

FIELD BABBITTED.

of a complete line of these couplings and accelerators.

The magnetic couplings are of the simplest possible form for a device of this

BACK PLATE WITH COIL.

BACK OF FIELD.

nature. They consist of two cast-steel rings mounted concentric with the shafts to be coupled. One of these rings has an annular groove, in which the magnetizing coil is securely fastened, the other ring acting as the armature or keeper. A cross-section of the two members shows the well-known form of a horseshoe magnet and its keeper.

This device is applicable wherever the shafts to be coupled are at rest or both running at the same speed when the coupling takes place. They can also be used to cut out a machine or section of shaft when in rotation, giving a prompt and absolute release regardless of load.

The magnetic speed accelerators are used for the same purpose as the ordinary friction clutch, except that they have a much wider range of application. The torque in these clutches is the sum of two components, one due to friction and one due to eddy currents induced in the armature plates by the magnetism of the field, which is specially constructed to secure this result. At the moment of starting the induction component of torque is a maximum, dropping off as the driven member attains speed.

In starting up a load with the ordinary friction clutch it is a noticeable fact that the pressure on the operating lever is eased the moment the load begins to move, in order to obtain a smooth start. In the

accelerator this is accomplished automatically by the dropping off of one component of the torque, the result being a remarkably smooth acceleration, which can be controlled, if desired, by means of a rheostat.

In practice these accelerators find their readiest application to that class of service where it is desired to control moderate or large sized units by some form of automatic device, such as a float switch, relay or electrical contact of any kind. For most work they can be thrown directly across the line without danger from shock or jar, as it is practically impossible to produce a sudden jerk with them.

The simplicity of their construction renders them easily balanced for speeds much higher than that for which the ordinary clutch is available. The small currents used in the magnetizing coil result in a simple and cheap controlling apparatus, two amperes being sufficient to control a 100-horse-power unit at the ordinary speed.

They are designed and built for heavy service, and ample wearing surface is provided so that no adjustment for wear is necessary. One of these clutches now in operation in the steel plate mill of the Riter Conley Company, at Leetsdale, Pa., has been starting a 100-horse-power load 200 to 250 times a day for the past three months, not having had any adjustment whatever, and is still operating as satisfactorily as when first installed.

In connection with gear trains this device is also used to operate a machine at different speeds, and this arrangement has proven very satisfactory in practice.

The principles of design and construction, as well as many applications of these accelerators, are well protected by patents, a number of patents having been issued on April 4 to the Cutler-Hammer Manufacturing Company, covering several inventions of Mr. H. H. Cutler, chief engineer of the company. These patents cover three distinct inventions which are radically new to the electrical art.

No. 761,411 discloses the magnetic-speed accelerator, to which allusion has already been made.

The patent shows the accelerator running in a bath of oil, and provided with large composite surfaces for resisting the frictional wear between the two members of the accelerator.

No. 786,425 discloses a magnetic-speed accelerator which utilizes solely the principle of induction for creating a torque during acceleration, this being supplemented by friction only when desiring to operate the load at full speed. This device will not be placed on the market at present.

No. 786,420. This illustrates another form of accelerator similar to that described in the preceding patent, but differing in construction.

No. 786,412 discloses a modified form of the type of accelerator described in patent No. 786,411.

No. 786,413 covers a method of control for the types covered by patents Nos. 786,425 and 786,420.

No. 786,414 covers a method of power transmission using a magnetic-speed accelerator which possesses the inherent property of gradual acceleration.

No. 786,415 discloses means for starting single or polyphase motors under load without disturbing the power-factor on the lines, and covers means for producing a suitable current for energizing the accelerators.

CLUTCH BEFORE ASSEMBLING.

No. 786,416 discloses a modification of the above, using small direct-current generators for producing magnetizing current for the accelerators.

No. 786,417 illustrates and covers a method of starting synchronous motors under load.

No. 786,418 covers a method of improving the power-factor on the line in starting alternating-current motors under load, utilizing the controllable, joint inductive and frictional slip of a magnetic accelerator mounted between the motor and its driven load.

No. 787,419 discloses a method of operating trains of cars driven by alternating-current motors, arranged on the multiple unit plan, so that all the motors may be started, stopped and reversed from any car on the train. The preferred system shows single-phase induction motors, provided with accelerators.

Patent No. 786,421 illustrates a system of apparatus for motor control especially adapted for the operation of large newspaper presses. The system utilizes a large motor and a small motor designed to operate the press at full speed and at slow speed, respectively. The magnetic clutch connects either motor to the driving shaft at will, and the speed of both motors is varied by one controller.

Nos. 786,422, 786,423 and 786,424 illustrate modified forms of a multiple unit system of controlling trains of cars using direct-current generators. The basic patents covering this system of control have been issued and were described a few months ago, these patents being numbered 776,220 and 777,778. The detail patents covering the practical application of this system have not as yet been issued, but show a much simpler form of control.

A Prize Contest for the Design and Finish of Motor Cars.

A prize competition of interest to artists and designers, as well as to owners and users of motor cars, has been arranged by the George N. Pierce Company, Buffalo, N. Y., manufacturer of the Pierce motor cars.

There is an offer of three sets of first and second prizes: first, for the best design of a body for an enclosed car; second, for the best design of a body for a touring car; third, for the best color scheme for any motor car. The first prize for each of the first two competitions will be $250, and the second prize, $100. For the last competition the first prize is $200, and the second prize, $100. The contest closes June 1, and prizes will be awarded as soon as a decision can be reached. Any one wishing to compete in this contest can secure full information and scale drawings by writing to the George N. Pierce Company, Buffalo, N. Y.

A One-Cent Telephone Call.

On Saturday, April 1, the Sandusky Telephone Company, Sandusky, Ohio, inaugurated a telephone system at a rate of one cent per call. A great many slot machines have been in use in Sandusky heretofore, and contracts are now being signed up by almost every one who has, in any way, any use for the system. The company reports that the new one-cent rate has met with a hearty response, and promises to become very popular.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TO MODERNIZE THE POWER PLANTS OF RIO DE JANEIRO—The Rio de Janeiro Tramway, Light and Power Company, which has been incorporated with a capital stock of $25,000,000 by American and Canadian capitalists, has perfected plans to install a modern electric railway and lighting system in Rio de Janeiro, Brazil. The power-generating plants will be forty-five miles from the city.

LARGE MORTGAGE FOR SPEIR'S FALLS COMPANY—The Hudson River Power Company, Glens Falls, N. Y., has given to the Knickerbocker Trust Company, New York, two mortgages—one of $5,000,000, and another of $2,000,000. These mortgages cover property of the power company at Speir's Falls, and are to secure the payment of $5,000,000 in bonds and $2,000,000 in cash lent to the power company by the trust company.

NEW POWER PLANT IN MEXICO—A new electric power plant will probably be established on the Pamico and Tamesi rivers, in Tamaulipas, Mexico. An investigation has been conducted for St. Louis parties by W. H. Marsden, to find a suitable site. He has reported that places have been found where the velocity of the water in the two rivers is nine and twelve miles per hour, respectively. Concessions are to be asked from the Mexican government for the construction of the plant.

PLANS FOR EXTENSIVE POWER PLANT IN INDIANA—Plans are under way for the formation of the Indiana & Michigan Electric Company, with headquarters at Mishawaka, Ind. The concern will have a capital of $2,000,000, and will control about 60,000 horse-power generated by plants located along the St. Joseph river in Indiana and Michigan. The energy will be distributed throughout Indiana and Michigan for lighting and railway work. Current will also be sold to manufacturing establishments.

TRACTION COMBINE IN OHIO—A certificate has been filed with the secretary of state, at Columbus, Ohio, combining the Ft. Wayne, Van Wert & Lima Traction Company and the Lima, Delphos, Van Wert & Ft. Wayne Traction Company, under the name of the Ft. Wayne, Van Wert & Lima Traction Company. The capital is $2,000,000, half of which is five per cent preferred. James Murdock, Lafayette, Ind.; D. J. Cable, Lima; John D. S. Neely, Lima; John B. Chapman, Pittsburg; H. C. Paul, Ft. Wayne; Chas. Murdock, Lafayette, Ind., and A. L. Kitselman, Muncie, Ind., are the directors.

MEXICAN ELECTRICAL NOTES—The manager of the San Ildefonso Hydraulic Power and Exploration Company, Mr. Emilio Penzon, has applied to the secretary of state for a concession to utilize 1,000 litres of water per second from the Tachos river. This is in addition to the company's power station already equipped, near the Veronica Calzada, on the line of the National railway. A new telephone system is proposed for Mexico City. The system will be almost entirely underground, the duct construction being of a specially designed form of cement blocks. The system will have a capacity for serving 40,000 subscribers if required.

COMPANY TO CONTROL ELECTRIC PLANTS IN RHODE ISLAND—The Blackstone Valley Company has been incorporated in Rhode Island by Charles H. Darling, Charles E. Ballou and Howard T. Metcalf. A bill has been introduced in the Rhode Island legislature, which if passed will give the incorporation power to lease and acquire the property, rights, contracts, powers and privileges of any gas, electric light, power, street railway or other railway company that may operate its road by electricity in Rhode Island, and with the power to acquire, hold and dispose of the stocks, bonds, securities and obligations of such corporations. The capital stock is not to exceed $3,000,000, of which $1,000,000 is to be preferred stock.

LARGE ELECTRIC RAILWAY SYSTEM IN COLORADO PLANNED—A company has been organized, with a capital of $2,700,000, to build an electric railroad, which will connect Pueblo, Colorado Springs, Florence and Cripple Creek. President Thomas Robinson, of the Florence Electric Street Railway, states that ground will be broken at once for the road. The first section, between Florence and Canon City, is to be completed before October 1. The road is to reach all the important points in the Arkansas valley between Florence and Colorado Springs, a distance of seventy-five miles. Both freight and passengers are to be carried. H. H. Cook and Harry Robinson, both of Florence, are vice-president and secretary, respectively, of the road.

KANSAS CITY & LEAVENWORTH ELECTRIC RAILROAD CHANGES HANDS—The Kansas City & Leavenworth Electric Railroad has been sold to the company which is to build the viaducts between Kansas City, Mo., and Kansas City, Kan. The purchaser bought $1,450,000 worth of bonds, and $1,500,000 in stocks. The new company will apply for franchises in both Kansas Citys, and proposes to build a system of urban and interurban lines reaching all cities within 100 miles of Kansas City. The road is to be extended from its present terminus in Leavenworth to Atchinson and to St. Joseph. A line will run to Lawrence, and Topeka ultimately, while another line will run to Olathe and Paola. It is probable the company will run a line later to Liberty and from that city to Excelsior Springs. The plans call for an ultimate expenditure of from $5,000,000 to $8,000,000 within the next five years.

FOR A NEW TELEPHONE COMPANY IN NEW YORK—A franchise application for a new telephone company in Greater New York was introduced at a session of the board of aldermen, New York city, last week. Under the resolution which was presented and referred to the committee on water supply, gas and electricity, a twenty-five-year franchise is asked for the New Amsterdam Telephone Company, with a renewal privilege at the end of the first period of twenty-five years. The company seeks to be empowered to place and operate telephone, telegraph and telautograph wires in the five boroughs, and to erect necessary poles and lay the necessary ducts in the various boroughs. The compensation to the city in return for the franchise is fixed at three per cent of the gross receipts of the company for the first twenty-five years. At the end of that period renewal terms are to be fixed by a commission of three, one of the members to be named by the board of estimate and apportionment, one by the company, and the third by the two members so chosen. In addition to the compensation provided in the resolution the New Amsterdam Telephone Company agrees to install free telephones in the various city departments, the number not to exceed 500.

NEW COMPANIES.

MARION, IND.—The H. F. Reynolds Electric Company has been incorporated with a capital of $20,000. The directors are H. F. Reynolds, B. F. Burke, Louise Reynolds and Roy Grunell.

ATLANTA, GA.—The Empire Electric Company has been organized by E. C. Peters, J. G. Clements and L. E. Moncrief, to manufacture electrical supplies. The company has a capital of $8,000.

NEW YORK, N. Y.—The Long Island Consolidated Electrical Company has been formed with a capital of $25,000. The incorporators are: D. Clarke, W. Y. Oakman, both of New York city; T. DeW. Cuyler, of Philadelphia, Pa.

JERSEY CITY, N. J.—Streator Independent Telephone and Telegraph Company has been formed with a capital of $200,000. The incorporators are Charles N. King, Le Grand Bouker and John J. Reilly. The company is to make and deal in telephonic and telegraphic apparatus.

BUFFALO, N. Y.—A certificate of incorporation of the Buffalo Pole Line Construction Company has been filed in the office of the county clerk. The company is capitalized at $10,000. It purposes to do a general business in building power plants, telegraph and telephone lines, etc. The directors are William E. Robertson, Clarion S. Saunders, Adolph G. Greenberg, Raymond D. Johnson and George B. Barrel.

TELEPHONE AND TELEGRAPH.

COUNCIL BLUFFS, IOWA—The city has voted to grant a franchise for an independent telephone exchange.

KOSCIUSKO, MISS.—The Kosciusko Telephone Company has begun extensive improvements on its lines throughout the city. New instruments are being installed, and new pole lines and cables erected.

LEONARDSVILLE, N. Y.—The Leonardsville Telephone Company will extend its line to Unadilla Forks this spring. Arrangements are well under way, and the line will probably be built on the Plainfield or east side of the Unadilla road.

HERKIMER, N. Y.—A franchise has been granted the County Telephone Company, of Herkimer, to extend its system and build a local exchange in Newport. This company is controlled by the Independent Telephone Securities Company.

BENSON, MINN.—The Benson Telephone Company has been reorganized as a stock company, under the name of the Swift County Telephone Company. The old lines will be removed and a cable line installed. About 100 miles of new farmers' lines will be built.

MINNEAPOLIS, MINN.—Telephones will be installed by the Chicago, Milwaukee & St. Paul Railroad between the villages of Millville, Hammond and Zumbro Falls, Wabasha County, to take the place of the telegraph system which was removed a few months ago.

WINONA, MINN.—The Winona Telephone Company has elected James A. Tawney, John Dietze, Edward Lees, S. L. Wright and J. R. Mitchell as directors, and the directors have elected the following officers: president, James A. Tawney; vice-president, John Dietze; secretary and treasurer, John Dietze.

CANASERAGA, N. Y.—A new telephone company has been organized in this vicinity for the purpose of running a line from Arkport to Canaseraga, *via* Bishopville. The officers are William Ellis, president; Dennis Karns, vice-president; John Bacon, treasurer, and Fred Howes, secretary. The line will probably connect with the Inter-Ocean.

PECATONICA, ILL.—The Winnebago County Telephone Company will build at once from Durand to Pecatonica, doubling the capacity of its exchange in the last-named town. Better service will be established with Freeport, by way of Durand. Shirland and Rockton will also be connected and extensions in other towns near Rockford will be undertaken.

LIVONIA, N. Y.—The Bell Telephone Company, of Buffalo, has purchased the system and exchange of the Livonia Home Telephone Company. The property consists of more than twenty miles of telephone right of way with wiring, an exchange at Livonia, and pay stations at Conesus, South Livonia, Hemlock, Livonia Center, South Lima and Lakeville.

OWINGSVILLE, KY.—A new telephone line will at once be built from Owingsville, Ky., to the eastern part of the county, connecting at Salt Lick with W. J. Fill's line, which runs to West Liberty, Morgan County. From there the lines will be extended to the remote sections of the mountains, which have now neither telephone nor telegraph facilities. The new line will connect with long-distance lines at Owingsville.

ELM HILL, W. VA.—The National Telephone Company has completed a survey and secured the greater part of the right of way for the construction of a new telephone line from Elm Grove to the Sand Hill region. The line when constructed will be on private right of way for the greater part of the distance and will be about six miles in length. Arrangements have been made for the starting of active work on the construction of the line.

PORT DEPOSIT, MD.—At a meeting for the reorganizing of the Cecil Farmers' Telephone Company it was decided to amend the charter by raising the capital stock from $5,000 to $25,000. Officers for the ensuing year were elected, as follows: R. E. M. Clenahan, of Port Deposit, president; Elwood Balderston and E. T. Dorens, vice-presidents. Nine directors were also elected, as follows: R. K. Rawlings, E. H. W. Holden, E. L. Duyekinck, Cecil E. Emory, Joseph Grove, Elwood Balderston, Carlton Kimble, R. E. McClenahan and E. T. Dorens.

CLEARFIELD, PA.—The Huntingdon & Clearfield Telephone Company has effected the purchase of the system owned by the Indiana Telephone Company in Indiana County, and the system in Northern Cambria County, known as the Cambria County Telephone and Telegraph Company. The latter system is an important one, connecting the towns of Carrolltown, Ebensburg, Hastings, Barnesboro, Spangler, Cresson, Gallitzin, Lilly and other prosperous towns and villages, and gives the Huntingdon & Clearfield line direct communication with Pittsburg.

GRAND RAPIDS, MICH.—The Western Union Telegraph Company will begin to place its downtown wires underground about the middle of April. It is now considered certain that the committee will report favorably upon the company's request for right to use the streets. The only change which is likely to be made is that the council's action may not specify the side of the street which the company may use, as was at first desired. The reason for this modification is that some of the streets are already pretty well filled up with wires on one side or the other.

CAMDEN, N. J.—The Eastern Telephone and Telegraph Company has completed a direct line to Bridgeton, Vineland, Millville, Salem, Tuckahoe, Bivalve and intermediate points. Heretofore communication with these towns was by way of Newfield. A large force of men is employed on the Cape May branch, and it is confidently expected that this line will be in operation by July 1. The Atlantic City service of this company has been thoroughly tested since its completion, and subscribers state that conversation between Camden and Atlantic City can be carried on as easily as if one was in his own home.

LEGAL NOTES.

GROSS RECEIPTS NOT THE VALUE OF A FRANCHISE—The Western Union Telegraph Company brought action against the city of Omaha, Neb., to enjoin the collection of a city tax levied upon the gross receipts representing a franchise which the company held in the city. The supreme court has held that the gross receipts in a given year of a telephone and telegraph company are not the value of a franchise of a corporation, and therefore can not be taxed as a franchise, though the amount of the gross receipts may be taken into consideration in determining the value of the franchise.

DECISION IN WIRELESS TELEGRAPH LITIGATION—In the United States Circuit Court for the District of New York Judge Townsend, on April 12, handed down an opinion in the suit brought by the Marconi Wireless Telegraph Company *vs.* the De Forest Wireless Telegraph Company, for alleged infringement of patents. The opinion is very much involved, and both litigants say that the decision is in their favor. The Marconi company bases its suit upon six claims, two of which Judge Townsend upholds. The other four are dismissed. Upon the two claims sustained the court allows an injunction and an accounting, holding that, so far as these two separate claims are concerned, the defendant has infringed.

PERSONAL MENTION.

MR. E. J. DOSS, county clerk of Shelbyville, Ky., has been elected secretary and treasurer of the Shelby Water and Light Company.

MR. H. T. SANDS, superintendent of the Lewiston & Auburn (Me.) Electric Light Company, has accepted the position of superintendent of the electric light plant at Haverhill, Mass.

MR. R. A. WALKER has accepted the position of general manager of the Central Iowa Telephone Company, with headquarters at Iowa Falls. He assumed his new duties April 1.

MR. A. L. TETU, general manager of the Home Telephone Company, Louisville, Ky., has resigned to accept charge of the Independent Telephone Company's plant in Nashville, Tenn.

PROFESSOR R. W. WOOD, of the department of physics of Johns Hopkins University, Baltimore, Md., has been elected an

honorary fellow of the Royal Microscopical Society, of Great Britain.

MR. JOHN D. TWIGGS, JR., city engineer of Augusta, Ga., has been appointed chief engineer of the work of surveying and building the electric railway line between Raleigh and Durham, in North Carolina.

MR. H. N. PEDRICK, superintendent of the Bristol County Electric Railway system, now the Taunton & Pawtucket, has resigned. He will be succeeded by Mr. E. H. Richards, of Framingham.

MR. H. C. ADAMS, JR., representing R. B. Corey, New York city, is about to make an extended trip throughout the country, in the interest of the various specialties for which R. B. Corey is eastern agent.

MR. CHARLES DAVIS has accepted the position of auditor of the Olean (N. Y.) Electric Railroad. This includes the electric lines to Bolivar, Shingle House, Allegheny, Salamanca and the Olean street railway.

MR. FRED GORDON has been appointed superintendent of the Lewiston and Auburn (Me.) Electric Light Company to succeed Mr. H. T. Sands resigned. Mr. Gordon was formerly assistant superintendent at the same plant.

MR. PAUL MILBURN, of Miles City, Mont., has been appointed assistant manager of the Helena office of the Rocky Mountain Bell Telephone Company. For more than a year Mr. Milburn has had charge of the telephone exchange at Billings.

MR. R. E. SPENCER GEARE, M. E., formerly consulting engineer to Colgate & Company, Newark, N. J., has severed his connection with the company, and will hereafter be identified with Walter S. Timmis, consulting engineer, 150 Nassau street, New York city.

MR. ROBERT J. CHAMBERS, Montgomery, Ala., has been appointed local executive head of the Montgomery Light and Water Power Company as vice-president and general manager. Mr. George A. Montgomery, consulting engineer, becomes, under the new management, general superintendent in charge of the execution of all the work of the company.

PROFESSOR HENRY S. CARHART AND PROFESSOR W. B. SCOTT have been invited to join the official party to attend the South African meeting of the British Association for the Advancement of Science, which will be held this summer. Professor Carhart holds the chair of physics at the University of Michigan, and Professor Scott, the chair of geology at Princeton.

MR. J. S. BELLAMY, for some years manager of the Mutual Telephone Company at Des Moines, Iowa, has resigned and will go to Hutchinson, Kan., to take charge of a line which he has established at that place. It is said that he will retain his interest in the company, remaining as president. Mr. C. H. Judson, the engineer in charge of construction, will take Mr. Bellamy's place temporarily.

MR. ARTHUR WILLIAMS has received for his report on municipal ownership, which is to be presented at the Denver-Colorado Springs convention of the National Electric Light Association, June 6 to 11, some fifty or more reports from foreign cities and towns, as well as a great quantity of information regarding municipal plants in this country. This report will be voluminous, and will, no doubt, be welcomed by all interests engaged in public service.

PROFESSOR WILHELM OSTWALD, of the University of Leipsic, has been invited by Harvard University to serve as lecturer during the first half of the coming academic year. This is under the arrangement for an exchange of professors which has recently been agreed upon by Harvard University and the German government. With J. H. van't Hoff Professor Ostwald founded in 1887 the *Zeitschrift fur Physikalische Chemie*, and in 1901 the *Annalen de Naturphilosophie*. Professor Ostwald is regarded as one of the founders of the modern science of physical chemistry. He has been a prolific investigator and writer. No definite announcement has yet been made regarding the course that he will give at Harvard.

OBITUARY NOTICE.

MR. THOMAS P. ESPY, superintendent of the Consolidated Gas and Light Company in Tiffin, Ohio, died suddenly of heart disease on March 31, at his home in Tiffin. He was sixty-eight years old. The body was taken to Kenton for burial.

ELECTRICAL SECURITIES.

Continuing the revival of bullish speculation inaugurated two weeks ago the market for the past week was considerably animated, and in every direction confidence appeared to dictate the appetite for investment and possibility of profit-making. Crop deposits will play an important part in the development of movements of great moment, and the initial government report on winter wheat bids fair to encourage the prophecy that the farmer will be in the market with money to spend. The prosperity of the iron and steel trade, the expanding railroad earnings, and reports of increased building operations all over the country assure a brisk season, extending even through the summer months.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 15.

New York:	*Closing.*
Brooklyn Rapid Transit	70⅛
Consolidated Gas	204¼
General Electric	184⅛
Interborough Rapid Transit	207
Kings County Electric	200
Manhattan Elevated	166½
Metropolitan Street Railway	122⅝
New York & New Jersey Telephone	170
Westinghouse Manufacturing Company	192

Boston:	*Closing.*
American Telephone and Telegraph	144⅝
Edison Electric Illuminating	255
Massachusetts Electric	68
New England Telephone	139
Western Telephone and Telegraph preferred	100

The $7,500,000 4 per cent bonds of the Boston Elevated Railway authorized by the railroad commissioners will be used for the following purposes: $130,000 for engineering and miscellaneous expenses in connection with proposed extension of railway; $900,000 for construction and equipment of proposed extensions of elevated structure, including foundation, tracks and electric system; $850,000 for construction and equipment of power stations; $170,000 for construction and equipment of terminal and other stations in connection with proposed extension; $1,300,000 for purchase and equipment of rolling stock; $3,700,000 for payment of necessary cost of real estate and the payment of damages caused by construction of the railway; $50,000 for purchase of machinery, tools and miscellaneous equipment; $300,000 for necessary cost of equipment of tunnels. These bonds have been awarded to Kidder, Peabody & Company, for a syndicate.

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	85½
Electric Storage Battery preferred	85½
Philadelphia Electric	11¼
Philadelphia Rapid Transit	35
United Gas Improvement	116¾

The annual report of the Philadelphia Electric Company for the year ended December 31, 1904, shows a gain in surplus over the previous year of $300,000. The income account also shows a gain of about $95,000. The gross income and expense charges, etc., increased in about the same proportion. The report is as follows: gross income, $3,873,911; expenses, charges, etc., $3,167,128; net income, $706,783; previous surplus, $800,134, giving a balance of $1,506,917; dividends, $406,261, making the total surplus $1,100,656, as compared with $800,134 for 1903. J. R. McAllister has been elected a director of the Philadelphia Electric Company, succeeding the late Charles M. Swain. Other directors have been reelected.

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	165
Metropolitan Elevated preferred	61½
National Carbon common	62
National Carbon preferred	114½
Union Traction common	8½
Union Traction preferred	37

H. G. Hetzler has been elected president of the Metropolitan West Side Elevated Railroad Company, and F. A. Delano, chairman of directors.

The city of Chicago has granted permission to the Northwestern Elevated Company to begin its Ravenswood extension.

The directors of the Chicago Edison Company have declared the regular quarterly dividend of 2 per cent, payable May 1.

ELECTRIC RAILWAYS.

LYNN, MASS.—The Nahant & Lynn Street Railway Company has been granted a charter.

COUNCIL BLUFFS, IOWA—The City Railway Company will expend about $20,000 in new car barns.

HATTIESBURG, MISS.—G. L. Hawkins, president of the First National Bank of Hattiesburg, will soon begin to build an electric railway in the town.

SYRACUSE, N. Y.—The State Board of Railroad Commissioners has authorized the Ithaca-Cortlandt Traction Company to increase its capital from $200,000 to $1,000,000.

SHARON, PA.—Sharon council has granted a franchise to the Shenango Street Railway Company, giving it the right to construct its lines over the various streets of the town.

WILMINGTON, DEL.—A franchise has been granted the South Wilmington Railway Company, permitting it to build a street railway from Front and Market streets to the city line.

NEWARK, N. J.—An electric railway line is contemplated from Orange to the South Mountain reservation, and it may possibly extend over the Orange mountains to Caldwell.

JAMESTOWN, N. Y.—The Warren & Jamestown Railway Company will complete this spring its new line from Jamestown to Warren, Pa., a city of over 8,000 inhabitants, twenty-one miles south of Jamestown.

NORRISTOWN, PA.—The extension of the line of the Schuylkill Valley Traction Company from Sanatoga to the centre of Pottstown will necessitate the installation of additional machinery at the power plant in Collegeville.

OCONOMOWOC, WIS.—The common council has granted the Milwaukee Light, Heat and Traction Company a franchise to construct its electric railway lines over certain streets. The road will be extended from Waukesha beach to Oconomowoc.

EL PASO, TEX.—George A. Nicholas, of Baltimore, and others have secured a franchise to build and operate an electric railway in El Paso. Two miles of road must be constructed within a year. The franchise also allows the company to supply light and power to the town.

LONG BRANCH, N. J.—The Atlantic Coast Electric Company is extending its lines from Spring Lake to Sea Girt. It is expected that cars will be run on the extension before the opening of the season. The extension will be double tracked and nearly three miles in length.

RALEIGH, N. C.—A charter has been issued to the Chapel Hill Construction and Supply Company for the construction of an electric road between Chapel Hill and Durham. The incorporators are Joseph Hyde Pratt, R. A. McLeod and Chas. S. Mangum. The capital is $25,000.

WASHINGTON, D. C.—The Maryland Construction Company has begun to take up options on a right of way for a railway connecting Baltimore and Frederick, Md. The company recently purchased sixty acres of land north of Frederick, which, it is understood, is to be the site of a power-house.

SEATTLE, WASH.—Two franchises have been granted for an electric railroad from Kirkland to North Bend. The commissioner has reserved the right to revoke one of the franchises when work is commenced under the other. One franchise was secured by Otto Stendahl and the other by John Cort.

BOSTON, MASS.—The Plymouth County Street Railway Company has been granted a charter by the Massachusetts secretary of state. It will operate a road from Rockland, through Hanover, Pepperell, Duxbury and Marshfield, to Kingston. The road will be 26.86 miles long, and the capital stock, $125,000.

ELMIRA, N. Y.—The Waverly board of trustees has voted to give the Chemung Valley Traction Company the requested franchises. The Chemung Valley Traction Company was recently incorporated. It is composed chiefly of Elmira and Waverly men, who propose to construct a trolley line from Elmira to Waverly.

OBERLIN, OHIO—The Oberlin & Lorain Railway Company has secured three-fourths of the consents needed to build an electric line from Oberlin to Lorain. The road will run in an almost direct line from Oberlin to the steel plant at Lorain and then into that town. At Lorain the new road will connect with the Lake Shore Electric.

COHOES, N. Y.—The Schenectady Railway Company will construct another interurban line this summer, in addition to its Saratoga and Cohoes extensions. The new line will extend from Rexford's Flats to a point near Latham's Corners, crossing the river at Dunsbach's Ferry, where it will connect with the proposed Cohoes extension.

GRASS VALLEY, CAL.—It is stated that John Martin intends to build an electric road from Grass Valley to Marysville, a distance of nearly fifty miles, according to the route just surveyed. He and his company already own the electric road between Grass Valley and Nevada City, and the line to Marysville will be an extension.

GOSHEN, IND.—Construction work on the proposed interurban electric railway between Goshen and Warsaw has been started, and will be pushed to completion as soon as possible. This (Elkhart) township has voted a subsidy of $25,000 to the line, which is to be constructed by the Winona Assembly Company, contingent upon the road's being in operation by July 4.

WHEELING, W. VA.—A franchise has been granted to the Steubenville-Wellsburg trolley line, and work upon the project will be actively pushed. The company is the Tri-State Traction Company, and the franchise granted authorizes construction along the county road from the north end of Wellsburg to Follansbee. Beyond the last named point the right of way is on private property.

HARRISBURG, PA.—The Cumberland Valley Railroad has purchased the rights and franchise of the Chambersburg & Gettysburg Electric Railway Company, and will complete the line to Gettysburg, the state forestry reservation at Graffensburg and other points. The railroad company will run electric cars to and from Waynesboro, using the tracks over which the steam cars now run.

EVANSVILLE, IND.—A subsidy of $30,000 has been voted in Montgomery township, Gibson County, for the extension of the Evansville & Princeton traction line from a point near King's Station, through Owensville, to the Posey County line. Work on the extension must begin within thirty days, and the subsidy is not to be paid until the work is completed. The subsidy was carried by 333 majority.

BLOOMDALE, OHIO—The Bloomdale council has been requested to grant a franchise to the promoters of the Bloomdale, Fostoria & North Baltimore Electric Railroad to construct a street car line through Bloomdale. This road will be built from Fostoria to Deshler, passing through the towns of Bloomdale, Bairdstown, North Baltimore and Hoytsville. Work will commence on the line as soon as all the right of way is secured. S. P. Douglas, of Toledo, is the promoter of this line.

KALAMAZOO, MICH.—A high-speed electric road, known as the Grand Rapids & Kalamazoo Valley Railway, is to be built from Kalamazoo to Grand Rapids. W. H. Patterson, the promoter, has announced the signing of contracts with the Westinghouse company for the equipment. The road will be sixty miles long and double tracked. Single-phase alternating current, at 3,000 volts, will be used. It is expected to have the road in operation by December 1. The directors of the company are W. H. Patterson, Frank Henry, E. J. Anderson, C. B. Kelsey and George Hefferan.

STAUNTON, VA.—It is understood that the Middlebrook & Newport Railway and Electric Company will begin work with a large number of hands, in the southwestern part of this county, on an electric car line. The line will begin at a point near Staunton, and will run in a southwesterly direction to a point at or near Newport, Augusta County. Later on the company proposes to extend the line to a point at or near the village of Rockbridge Baths, in the county of Rockbridge. The following are the incorporators and directors: W. W. Sproul, J. Frank Clemmer, John H. Bowman, T. M. Smiley, W. C. Bosserman, Edward Echols, Richard Hogshead, and L. L. Bowman. Edward Echols is president of the company.

ELECTRIC LIGHTING.

RICHLAND CENTRE, WIS.—A new electric light plant has been completed at a cost of $20,000.

MONTREAL, CANADA—The town of Westmount is preparing to install a 600-horse-power electric plant.

BROOKHAVEN, MISS.—The Brookhaven city council has placed an order for fifty new arc lamps for the city streets.

LEOMINSTER, MASS.—The town of Leominster has voted against the installation of a municipal electric light plant.

WICHITA, KAN.—H. G. Landis, of Wichita, has secured a franchise for furnishing electric lights in the city of El Dorado.

LAUREL, MISS.—The city of Laurel is figuring with the Laurel Improvement Company for the purchase of the electric light and power plant.

ST. AUGUSTINE, FLA.—The St. Augustine Gas and Electric Company, which owns an electric light franchise in St. Augustine, will install a plant immediately.

EASTHAMPTON, MASS.—At a meeting of the directors of the Easthampton Gas Company it was voted to discard the electric plant now used for lighting the streets and to install an entirely new plant.

LIVONIA, N. Y.—A stock company, consisting of prominent business men of Livonia, has purchased the plant of the Stedman Electric Company. The new company will make several improvements in the plant.

ABERDEEN, WASH.—Plans are being drawn for an extensive addition to the plant of the Grays Harbor Lighting Company in East Aberdeen. The new building will be 45 by 96 feet, and twenty-two feet high.

MEDINA, N. Y.—The Niagara Falls Power Company, which is extending its power lines toward the east, through Medina, has applied to the board of trustees for a franchise to furnish light, heat and power in Medina.

BALTIMORE, MD.—Jacob Peters has secured the contract to build the large addition to the power-house at Herring Run for the Baltimore County Water and Electric Company. The addition will be one story high and will cover a space of 42 by 74 feet.

WINNIPEG, MANITOBA—At a meeting of the Calgary city council it was decided to go ahead with the installing of a civic electric plant for domestic and street light, at a cost of $60,000. Mr. R. S. Kelsh, of Montreal, has been selected as consulting engineer.

LYONS, N. Y.—The Wayne County Electric Company will expend $5,000 this spring in improvements to the plant and in replacing its feed wires throughout the village. About fifteen miles of copper wire will be used. Additional machinery will also be installed at the plant.

MISSOURI VALLEY, IOWA—C. H. Deur, A. Edgecomb, H. M. Cramer and George A. Kellogg, the owners of the Missouri Valley Electric Light, Power and Telephone Company, have sold their business and plant, located at Missouri Valley, to L. A. Little, of Buffalo Lake, Minn. The consideration was $70,000.

RITZVILLE, WASH.—The electric light plant has changed hands, C. O. Greene disposing of the same to N. H. and O. H. Greene, president and cashier, respectively, of the Pioneer State Bank, who plan to spend considerable money on the plant in the near future, rewiring Ritzville, and putting in new machinery.

COLUMBUS, IND.—The Ryan Construction Company, of Indianapolis, has been awarded the contract to build and equip an electric light plant in Hope. A sufficient number of arc lamps will be put up to light the streets of the town, and commercial lights will also be furnished. George S. Cook is the owner of the new plant.

STILLWATER, MINN.—The Stillwater Gas and Electric Light Company has accepted a ten-year contract from the city of Stillwater for lighting the streets with electricity. Private consumers of both gas and electricity will reap a substantial gain, the company having agreed to reduce the price of gas about twenty per cent, and the price of electricity one-third.

CANAAN, CT.—The work on the dam for the Berkshire Power Company is completed. Other work connected with the plant has been delayed on account of high water. A brick power-house sixty feet long is to be erected. The Berkshire Power Company has recently purchased the Sharon plant, which is to be run in connection with the plant on the Housatonic river.

CHARLESTOWN, N. H.—The Charlestown Water and Power Company incorporators have chosen Frank W. Hamlin, William H. Tinker, Fred H. Perry, John E. Allen and W. L. Mason directors. The directors chose Frank W. Hamlin, president; Fred H. Perry, clerk, and W. H. Tinker, treasurer. It is expected that work on the final survey will commence at an early date.

POST FALLS, IDA.—Work is being pushed rapidly on the electric plant being constructed at Post Falls, and it is expected that the plant will be completed and ready for operation next fall. It is being built by the Washington Water and Power Company, and is to be one of the largest power plants in the Northwest. The capacity will be 25,000 horse-power, and the cost of the completed enterprise will be between $500,000 and $600,000.

NELSON, BRITISH COLUMBIA—L. A. Campbell, manager of the West Kootenay Power and Light Company, whose extensive works at Bonnington Falls are now undergoing improvement, has announced that his company has entered into contracts to supply the Granby Mining and Smelting Company and the British Columbia Copper Company in the boundary with 4,500 horse-power. The new installation now in process will cost $1,000,000.

CHICAGO, ILL.—The Calumet Lighting Company, formerly the Calumet Gas and Electric Company, has conveyed to the North Shore Electric Company for the nominal consideration of one dollar property in Harvey and Chicago Heights. The conveyance includes all property, real, personal and mixed, lands, waterworks and electrical plants. The deal is subject to a lien of a trust deed dated July, 1902, given by the United Water and Light Company to the American Trust and Savings Bank, as trustee, for bonds amounting to $200,000.

NEW HAVEN, CT.—New Haven interests, which already control the Springfield, Mass., Gas Light Company; the Malden Electric Company, of Malden, Mass.; the Suburban Electric Company, of Revere, Mass., and the Haverhill Electric Company, of Massachusetts, have acquired the Concord, N. H., Electric Company. The new concern is the only company supplying electricity to the city of Concord, and has a perpetual franchise. The population of the city is about 20,000. The capital stock is $350,000 and there is a bond issue of $350,000 authorized.

GAINESVILLE, GA.—Preparations are being made to begin active work at an early date upon the new dam at Wilson's Shoals, about six miles from Gainsville and about ten miles down the river from the Dunlap dam. The North Georgia Electric Company is constructing the plant. The new development will be approximately the size of the dam and power plant at Chattahoochee Park, Dunlap Shoals. The height of the dam will be about thirty feet, the length of the spillway 400 feet, the production of power about 3,000 to 3,500 horse-power.

OMAHA, NEB.—A second mortgage upon the plant of the Citizens' Gas and Electric Company has been filed for record. It is given to secure an issue of $300,000 second mortgage bonds held by the American Loan and Trust Company, of Boston. The Omaha Electric Light and Power Company guarantees the payment of the principal and interest of the bonds. The new issue is stated to be for the purpose of taking up the former bonded indebtedness, as well as to secure funds with which to pay floating indebtedness, for improvements made during the last year and for improvements to the amount of $50,000 or more contemplated during the present season.

NYACK, N. Y.—A meeting of the stockholders of the Orange & Rockland Electric Company was held recently. Charles R. Bull, of Oxford Depot, was elected chairman, and Gilbert Carpenter, of Monroe, was made secretary. After discussion it was voted to organize with a capital stock of $50,000. These directors were elected: Zael Paddleford, Luther Terwilliger, Monroe; Frank Durland, George M. Roe, Chester; A. Creelman, Fred W. Snow, R. J. Davidson, Hillburn. A central generating plant will be established in Monroe, and current will be furnished for lighting Monroe, Chester and surrounding villages. The directors hope to have the plant in operation early in July.

INDUSTRIAL ITEMS.

THE McGUIRE-CUMMINGS MANUFACTURING COMPANY, Chicago, Ill., announces that the Chicago City Railway Company has placed an order with it for 424 of its standard Master Car Builders' trucks, to be placed under new cars recently purchased.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has issued a catalogue describing the "Simplicity" theatre dimmer. The catalogue is handsomely got up, and contains descriptions and illustrations of a large variety of theatre dimmers, and also a list of the dimmers installed.

THE STANDARD VARNISH WORKS, New York city, is mailing a large folder calling attention to quick-drying "Voltalac," "Gutta-Percha Black Finishing" and "Gutta-Percha Light Finishing." In order to prove its words in regard to its goods, the company makes a proposition to ship a gallon of each of these varnishes as a trial order.

THE BATES MACHINE COMPANY, 346 Broadway, New York city, has established a branch office in Chicago, Ill., in the Manhattan Building, 315 Dearborn street. The office will be in charge of C. K. Eberts, formerly with Barnhart Brothers & Spindler. This office will carry a full stock of standard models of hand and typographic numbering and dating machines. So that orders for such goods may be filled with great promptness.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, Ill., has shipped an additional increase of capacity, consisting of one section of multiple switchboard for the Independent exchange at Springfield, Mo. This is the second increase made by the Springfield company since the original installation. The Springfield company reports a very brisk demand for telephones, and it became necessary to increase the capacity of the switchboard a full section.

THE DEAN ELECTRIC COMPANY, Elyria, Ohio, is distributing folder No. 1, illustrative and descriptive of its compact type telephones. This literature is attractive and instructive. Diagrams are given, showing the connections of series telephones, bridging telephones, ring-through telephones, non-interfering telephones, divided-circuit telephones, four-party selective telephones, and central checking telephones. The company is prepared to furnish special telephones upon request.

THE ELMER P. MORRIS COMPANY, 15 Cortlandt street, New York city, manufacturer and exporter of electric lighting and railway supplies, will be pleased to send its general catalogue, No. 6, to any one interested in wrought-iron and steel tubular poles and pole brackets for electric railways, electric lighting and telephone and telegraph service. This book gives diagrams and illustrations of various forms of service apparatus and tables of standard weight tubing, in both English and metric systems.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., will be pleased to send their literature concerning P. & S. porcelain fixture sockets and P. & S. temporary sockets or receptacles for decorative wiring. This latter apparatus saves time and labor, it being unnecessary to use solder, tape or compound. The socket can be installed without opening it, and is placed on the line after the wires are set up. It is to be used with standard stranded wire, without removing or injuring the insulation.

THE AMERICAN CIRCULAR LOOM COMPANY, Chelsea, Mass., announces that the National Board of Fire Underwriters, after careful consideration at an open meeting held by the special committee, has cancelled all the specifications of rule 50-C of the electrical code, referring to the construction of flexible tubing, and has directed that circular loom of the type made by the company during the past twelve years be put back upon the list of approved fittings, and that this change be noted in the April supplement to the electrical code to be issued shortly.

THE SWITCHBOARD EQUIPMENT COMPANY, Pittsburg, Pa., in its bulletin No. 1, describes direct-current circuit-breakers with overload relays. In its introductory note the company states that it does not make switchboards, but that it does make circuit-breakers. The endeavor has been made to outline clearly and concisely the essential features of these breakers. Designs are based upon broad engineering experiences in circuit-breaker work, and a careful consideration of the requirements. The illustrations show the circuit-breakers both in diagram and perspective.

S. H. COUCH COMPANY, INCORPORATED, Boston, Mass., will be pleased to send bulletin No. 10, describing single-speaking circuit battery call telephones. The company also manufactures automatic reset intercommunicating telephones, rotary switch intercommunicating telephones, plug switch intercommunicating telephones, either in battery or magneto call. Catalogues will also be sent upon application descriptive of magneto call exchange telephones, central energy battery telephones, drop shutter switchboards, target signal switchboards, telephone annunciators and telephone parts.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending to its telephone customers a new catalogue and price list (No. 23), in which are listed telephones, appliances and construction material. On the first page of the book is a partial view of the Central Electric Company's new headquarters at 207-211 East Jackson Boulevard. A complete line of telephones, parts and materials is listed, and the company states that the prices quoted are the lowest in force. The catalogue is attractive, and the company requests that all users of this material who have not received a copy should write for one at once.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a number of new publications. One of these is entitled "Fan Motors." It contains about fifty pages, and describes alternating and direct-current fan motors. The fans illustrated are desk, wall and ceiling fans, together with their accessories. A second pamphlet deals with the Curtis steam turbine. This pamphlet contains twenty-five pages, and consists principally of photographs of existing installations. Accompanying this is a partial list of Curtis turbines already installed and under construction. "Motor-Generator Sets" is the title of a third pamphlet which describes various motor-generator and booster sets built by this company and installed in various electric stations. The company has also issued bulletin No. 4403, describing the separate adjustable shunt field coil for the Thomson recording wattmeter.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Coal City, Iowa; Rochester, N. Y.; Yorkshire, Ohio; Round Knob, Ill.; Jefferson City, Tenn.; Rockford, Ill.; Ossian, Ind.; Castalia, Iowa; Minot, N. D.; Hemlock Lake, N. Y.; Ames, Iowa; Kimball, Minn.; Birmingham, Ala., and Des Moines, Iowa. A contract has recently been closed with the United States Telephone Company, of Cleveland, Ohio, for one of the largest toll boards ever built for a telephone company. The equipment is to consist of the following apparatus: eleven toll sections of two operators' positions each, to be arranged in one line. Two recording sections of two operators' positions, arranged in one line. One rural section. One paystation and heavy users' toll section; both of these sections will be arranged in one line. One test board. One chief operator's desk; this is to be a flat-top desk with a turret in the centre, so equipped that the chief operator can use one side, and the assistant operator use the other side. One switching section. One messenger call box; this arrangement consists of an annunciator box running to each operator's position, who can, by pressing a key, light a lamp in the call box. The lamp is covered with a lamp cap about one inch in diameter, with a numbered opal. The cabinets are to be built of solid mahogany.

AUTOMOBILE NOTE.

AUTOMOBILE CLUB OF AMERICA—A club smoker will be given at the club-house of the Automobile Club of America, 753 Fifth avenue, New York city, on Tuesday evening, April 25, at 9 P. M. This will be the concluding event of the season's house entertainments. Through the courtesy of Mr. Emerson Brooks the house committee has arranged an enjoyable programme. Supper will be served at 10.30 P. M.